Source Control Alternatives Evaluation
Operable Unit 2
Swan Island Upland Facility
Portland, Oregon

Prepared for:
Port of Portland

November 21, 2012
1115-05/Task 15

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1.0 Introduction

1.1 Purpose

This report presents the results of the Source Control Alternatives Evaluation (SCAE) for operable unit (OU) 2 (the Facility) of the Swan Island Upland Facility (SIUF) located at 5225 N Channel Avenue in Portland, Oregon. A Source Control Evaluation (SCE) and an SCE Addendum were prepared for OU2 and concluded that an SCAE was warranted (Ash Creek Associates [Ash Creek], 2010 and 2011). Figure 1 shows the location of the SIUF, and Figure 2 shows the boundaries of OU2. This SCAE was prepared in response to a request by the Oregon Department of Environmental Quality (DEQ) to identify, evaluate, and control sources of contamination that may reach the Willamette River consistent with the DEQ-EPA Portland Harbor Joint Source Control Strategy (JSCS; DEQ, 2005).

1.2 Regulatory Framework

This work is being conducted under an agreement between the Port of Portland (Port) and DEQ – Voluntary Agreement for Remedial Investigation, Source Control Measures, and Feasibility Study – dated July 24, 2006. For the purposes of the work conducted under that agreement, the SIUF has been divided into four OUs designated as follows.

- OU1 – Approximately 57 acres of upland property owned by Shipyard Commerce Center LLC (formerly Cascade General), and operated as the Vigor Marine Ship Repair Yard and formerly known as the Portland Shipyard.
- OU2 – Approximately 24 acres of upland property owned by the Port south of N Channel Avenue, formerly referred to as the N Channel Avenue Fabrication site.
- OU3 – Approximately 2.5 acres of upland property owned by the Port on N Lagoon Avenue that includes the property at 5420 N Lagoon Avenue and the adjacent property to the north that provides access to Berths 308 and 309.
- OU4 – Approximately 7.8 acres of upland property between OU1 and OU2. Until 2008, OU4 was part of OU2, but was designated a separate OU to facilitate the sale of the property from the Port to Shipyard Commerce Center LLC.

Figure 2 shows the locations of the OUs. The riverside boundary of the OUs is the ordinary line of high water (OLHW) of the Willamette River.

1.3 Report Organization

A description of the Facility and discussion of the investigation conducted at OU2 are presented in Sections 2 and 3 and on Figure 3. Specific objectives of the proposed source control are presented in

Section 4. Section 5, Figure 4, and Appendix A describe the areas targeted for source control. Section 6 evaluates potential source control measures and the recommended source control measure is presented in Section 7 and on Figure 5.

2.0 Site Background

2.1 Facility Description

The following Facility description is summarized from the SCE and SCE Addendum (Ash Creek, 2010 and 2011).

Figure 2 shows the layout of OU2 at the SIUF. The property covers approximately 24 acres on the south side of Swan Island, south of N Channel Avenue. The bulk of the property consists of a rectangular parcel of land between N Channel Avenue and the Willamette River OLHW. The remainder of the property is a narrow strip of land between OU4 and the OLHW. The length of the property fronting the Willamette River is 2,700 feet. Except for the slope along the riverbank (between top of bank and the OLHW), OU2 is relatively flat. Land surface elevations generally range between 30 and 34 feet (National Geodetic Vertical Datum [NGVD] of 1929 with the 1947 adjustment) in the upland areas.

Nearly 20 acres of OU2 are leased from the Port by two parties. The remainder of OU2 is generally vacant. Figure 3 is a Facility plan overlain on a 2011 aerial photograph showing the various use boundaries. Daimler Trucks North America LLC has the leasehold for approximately 7 acres at the southeast end of OU2. The leased property is used to temporarily stage trucks and trailers. This portion of OU2 is almost entirely covered with compacted gravel. There is one small wooden building located on the east side of OU2. Cemex has a leasehold on 12.1 acres in the central portion of OU2 to operate a concrete batch plant. Operational features include the concrete mixing plant, truck scale, mixer truck parking area, aggregate storage piles, a storm water treatment swale, and a process water storage/settling pond. Process water and storm water from the batch plant are collected and used in the concrete manufacturing process. In the eastern corner, near N Channel Avenue, is a truck fueling area. The fueling area uses an aboveground storage tank, is covered, and completely contained. Areas near N Channel Avenue around the truck scale and the batch plant are paved. The remainder of the ground surface is compacted gravel.

Between OU4 and the top of the riverbank is 2.7 acres of vacant land. The vacant property is covered with compacted gravel.

A detailed description of the riverbank is presented in the SCE Addendum (Ash Creek, 2011). Between OU2 and the river (below the OLHW), the riverbank is covered with rock, concrete debris, rip-rap, and beach sand. Above the OLHW, willows, Himalayan blackberry, and weedy vegetation are well established. Much of the riverbank appears stable, but erosion features are present as described further in Section 3.1.

2.2 Upland Investigations

Since 2000, the Port has completed facility-wide OU-specific RI activities. These investigations and the corresponding data relevant to OU2 are summarized in the SCE (Ash Creek, 2010). Following the SCE, additional riverbank sampling was completed with the results summarized in the SCE Addendum (Ash Creek, 2011).

3.0 Site Characterization

This section describes the potential transport mechanism (bank erosion) and source materials (bank soil) that are addressed by this SCAE. The SCE (Ash Creek, 2010) and SCE Addendum (Ash Creek, 2011) evaluated the range of potential transport mechanisms and source materials and concluded that erosion of bank soil is the only pathway and source that warrants an SCAE. The following sections summarize the results of the evaluation for that pathway and source.

3.1 Potential Bank Erosion

The erosion evaluation presented in the SCE/SCE Addendum shows that erosion of the riverbank has occurred and that further erosion is possible. The past and potential future erosion is associated with wave action against unprotected (i.e., inadequate riprap or vegetation) riverbank. Based on locations of observed erosion features, the potential for erosion occurs when the river level exceeds elevation 15 feet NGVD.

The riverbank is characterized by dense vegetation above the OLHW and riprap and sandy beaches below the OLHW. The bank reconnaissance conducted as part of the SCE Addendum identified multiple features on the riverbank such as man-made structures and erosion scarps. Six erosion scarps were identified along the riverbank. Figure 3 shows the locations of the observed erosion features.

The erosion scarps are linear features running parallel to the riverbank. They are located at or above the transition from riprap to vegetated riverbank. The total length of the scarps is 830 feet (or 30 percent of the total bank length). Of that total, approximately 300 feet of the scarps encroach below the OLHW (toe elevations ranging from 15.0 to 16.6 feet NGVD). The observed characteristics of the erosion are consistent with wave action (caused primarily by vessel wakes). The majority of the riverbank is covered with riprap or dense vegetation and has no evidence of erosion, demonstrating that riprap and vegetation are effective at preventing erosion when adequately implemented.

The longest single erosion scarp at OU2 (635 feet long) is roughly centered on the aggregate barge conveyor serving the Cemex facility. The Cemex facility began operation in 2007. The most recent prior reconnaissance of the riverbank was conducted in October 2005 in association with the ecological risk

assessment for OU2. This erosion scarp was not observed at the time of the 2005 reconnaissance. It is inferred that the erosion at this location is associated with the movement of barges in and out of the mooring location.

3.2 Evaluation of Riverbank Soil

Metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and tributyltin (TBT) were detected above JSCS screening level values (SLVs) in riverbank soils. As discussed in the SCE Addendum, TBT is not likely to be a risk-driver at OU2, so the following summary of the screening level evaluation focuses on metals, PAHs, and PCBs. Figure 3 shows the riverbank soil sample locations.

Metals. Arsenic, cadmium, copper, lead, and zinc were detected at least once above background and the soil/storm water sediment SLVs. Lead was most frequently detected above the SLV (18 of 23 samples). The other metals were detected above the SLV five times or fewer. Except for two sample locations (RB-9 and RB-10), metals enrichment ratios (ER; concentration divided by SLV) were five or less (RB-1 through RB-7 are composite samples; 2 of 12 composite subsamples analyzed for lead had ERs between 5 and 10). At RB-9a, lead was detected at an ER of 13. At RB-10b, copper and lead were detected at ERs of 11 and 26, respectively.

PAHs. Anthracene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene were detected at least once above the soil/storm water sediment SLVs. Indeno(1,2,3-cd)pyrene was most frequently detected above the SLV (seven of 23 samples). The other PAHs were detected above the SLV four times or fewer. Except for one sample location (RB-10b), PAH ERs were four or less (RB-1 through RB-7 are composite samples; one of nine composite subsamples analyzed for PAHs had an ER for indeno(1,2,3-cd)pyrene of 7). At RB-10b, indeno(1,2,3-cd)pyrene was detected at an ER of 11.

Total PCBs. Aroclor 1254 was detected in one of 25 samples and Aroclor 1260 was detected in 19 of 25 samples. Except for Aroclor 1260 in sample RB-10b, the detected Aroclor concentrations were less than respective SLVs. The Aroclor 1260 concentration in RB-10b had an ER of three. The total PCB concentrations for each of the riverbank soil sampling locations where PCBs were detected exceeded the total PCB JSCS bioaccumulation SLV (at ERs of 20 to 1,600). Except for sample locations RB-9 and RB-10, ERs for total PCBs ranged between 20 and 230, and outside of the RB-9 and RB-10 area, there is no apparent pattern to the distribution of PCBs on the riverbank. The three highest relative detections of PCBs (ERs from 400 to 1,600) were in samples from locations RB-9 and RB-10.

Riverbank Erosion Pathway Chemical Summary. Riverbank soils contain arsenic, cadmium, copper, lead, zinc, anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and PCBs at concentrations above respective SLVs. For the source control alternatives evaluation, these are considered to be chemicals of potential concern (COPCs). Higher relative concentrations are located in the area of two sample locations, RB-9 and RB-10. Chemicals detected in riverbank soils are summarized as follows:

- Area of Samples RB-9 and RB-10
    - Metals – Copper ER up to 11; lead ER up to 26
    - PAHs – Indeno(1,2,3-cd)pyrene ER of 11 in one sample
    - PCBs – Aroclor 1260 ERs up to 3; total PCB ERs range up to 1,600
- Remainder of OU2 Riverbank
    - Metals – Primarily lead; ERs range up to 5
    - PAHs – ERs range up to 4
    - PCBs – Primarily Aroclor 1260; total PCB ERs range up to 230

4.0 Source Control Objective and Evaluation Criteria

4.1 Source Control Objective and Goals

4.1.1 Source Control Objective

The Source Control Objective (SCO) for the OU2 riverbank soil is to prevent erosion of soil into the river at concentrations that could result in sediment concentrations above remediation goals (RGs) following cleanup of the Portland Harbor.

4.1.2 Source Control Goal

The Source Control Goals (SCGs) are chemical concentrations to be achieved in the OU2 riverbank soil that may be subject to erosion such that the SCO will be achieved. The SCGs may be achieved by either removing soil or controlling erosion of soil that contains chemicals above the SCGs. It was assumed that the SCO would be achieved if the riverbank SCGs are set equal to the harbor sediment RGs. Sediment RGs have not yet been selected, so the currently proposed RGs in the draft Portland Harbor feasibility study were used as SCGs. The SCGs for the source control COPCs are listed below.

- Arsenic – 17 milligrams per kilogram (mg/kg)
- Cadmium – 3.5 mg/kg
- Copper – 150 mg/kg
- Lead – 91 mg/kg
- Zinc – 320 mg/kg
- Benzo(a)pyrene Equivalent (BaPEq) – 420 micrograms/kilogram (µg/kg)
- Total PCBs – 30 µg/kg

For the riverbank source control, soil data will be evaluated based on averages (90 percent upper confidence limit of the mean). This approach is justifiable because:

- BaPEq and PCBs will be evaluated in sediment based on area-weighted averages over not less than one-half river-mile segments;
- The length of the OU2 riverbank is one-half mile, consistent with the segments being used in the harbor;
- There are sufficient samples from the riverbank for a statistically valid analysis (17 to 20 samples for each chemical); and
- Although metals will be evaluated on a point-by-point basis for harbor sediments, the mechanism for potential exposure to riverbank soils is erosion and subsequent transport to sediment. This process will tend to disperse and mix the soils so a statistical average more closely models potential exposure point concentrations in sediment than a point-by-point comparison to *in situ* soil concentrations.

4.2 Evaluation Criteria

The riverbank source control alternatives were evaluated using the criteria referenced in JSCS for Source Control Alternative Evaluation and Design. These criteria are effectiveness, implementability, and relative cost as described below in this section.

4.2.1 Effectiveness

This criterion includes both the long-term effectiveness of the technology to prevent soils from eroding into the river and the feasibility of minimizing short-term risk (i.e., implementation risk) of erosion during construction, as further described below. In addition, viable alternatives must provide a threshold level of environmental protection that prevents erosion of impacted soils to the aquatic environment.

- Long-Term Effectiveness. The effectiveness criterion considers the ability of an alternative to provide long-term environmental protection. An effective technology must be able to withstand scour and erosion that could destabilize the bank.
- Implementation Risk. The objective of this criterion is to minimize short-term risks to the environment associated with construction activities. Impacted soil may be exposed by re-grading certain parts of the bank, creating a risk of erosion into the aquatic environment. Although such impacts should be avoided to the extent practicable, in some cases it may be necessary to tolerate some amount of short-term environmental risk to gain long-term environmental protection. Engineering controls (e.g., silt fences) are used in these cases to reduce implementation risk.

4.2.2 Implementability

The implementability criterion considers a number of factors that affect the practicability of constructing a particular alternative. These factors include the following.

- Operational Constraints. Upland and waterside operations must not be compromised by the technology. For example, the integrity of adjacent structures and rights of way must not be undermined by excessive removal of the bank.
- Consistency with Adjacent Remedial Actions. The proposed alternative must be consistent with the adjacent upland and in-water remedies, to the extent the design of these final remedies can be anticipated, as well as any proposed remedial actions associated with the Portland Harbor Superfund site.
- Permitting. This factor considers the ease of obtaining permits for the source control alternative, or the ease of fulfilling the substantive requirements of permits exempted under the Comprehensive Environmental Response, Compensation, and Liability Act and/or DEQ rules.
- Consistency with Current and Future Land Use. A source control alternative should not conflict with existing or anticipated future land use, especially water-dependent land use. For example, heavy industrial waterfront usage may conflict with the use of shallow, bioengineered slopes and wide riparian buffer zones.
- Sustainability. Sustainability considers the overall use of resources associated with a technology including energy and natural resources used to manufacture, install, and maintain the elements of the technology.

4.2.3 Cost

The relative cost to implement a source control alternative is developed at a conceptual level by comparing relative unit costs for various technologies.

5.0 Extent of Riverbank Warranting Source Control

Figure 4 shows the proposed source control measure (SCM) areas. Appendix A presents the soil data and calculations used to define the action areas. Erosion features L and M are targeted for source control. These features are described as follows.

- L – Erosion scarp located above the OLHW (toe elevation of 19.5 to 20.8 feet NGVD), 56 feet long, and up to 3.0 feet high.
- M – Erosion scarp located above the OLHW (toe elevation of 20.3 to 21.8 feet NGVD), 53 feet long, and up to 2.7 feet high.

6.0 Technology Evaluation and Source Control Alternatives Development

This section describes and evaluates the source control technologies applicable to a SCM for the riverbank.

6.1 Screening of General Approaches

General approaches for SCMs at the OU2 riverbank include the following:

- No Action;
- Institutional Controls;
- Removal;
- Containment/Engineering Controls;
- Biological Treatment; and
- Physical/Chemical/Thermal Treatment.

No Action. A detailed evaluation of the need for source control was prepared in the SCE/SCE Addendum (Ash Creek 2010 and 2011) that determined that source control was appropriate at OU2. Therefore, a No Action alternative was not retained.

Institutional Controls. Institutional Controls consist of physical or legal barriers to prevent access to areas of concern. Institutional Controls would not prevent erosion of soil to surface water so were eliminated from further consideration.

Removal. Potentially erodible soils could be excavated and disposed of in an off-site landfill. After excavation, the bank would be stabilized against potential erosion from wave, current, or wind action; however, these same stabilization technologies would be sufficient to address the erosion concerns without the excavation and filling. Therefore, stabilization technologies would provide a more feasible approach for source control of the riverbank and removal was eliminated from further consideration.

Containment/Engineering Controls. Technologies in this category include capping and stabilization. These technologies prevent direct contact with (for terrestrial receptors) and erosion of surface soils. These technologies would be required with any other approach, but are capable of achieving the project objectives without other technologies. The studies completed as part of the SCE/SCE Addendum (Ash Creek, 2010 and 2011) demonstrated that the overall riverbank is stable and that well-established riprap and vegetation are successful in preventing surface erosion. Therefore, stabilization technologies were retained for further consideration.

Biological Treatment. Some of the source control chemicals of concern (COCs) such as metals are not amenable to biological treatment under normal circumstances. Furthermore, biological treatment can take time during which the soils would be susceptible to erosion. For these reasons, biological treatment was eliminated from further consideration.

Physical/Chemical/Thermal Treatment. Chemical and thermal treatment are not compatible with some of the source control COCs. Physical treatment (e.g., solidification) could achieve the project objectives at high relative cost, but would not be compatible with City Greenway standards (the resulting condition would not be suitable for planting native species). Therefore, physical/chemical/thermal treatments were eliminated from further consideration.

6.2 Description of Stabilization Technologies

To address erosion of the OU2 riverbank, four bank stabilization technologies were considered for application: slope re-grading and re-vegetation, riprap armoring, articulated concrete block (ACB) armoring, and a geosynthetic cellular confinement system (CCS).

6.2.1 Slope Re-grading and Re-vegetation

Slopes along the bank are over-steepened at the erosion scarps and re-grading will improve long-term stability. Based on performance of the existing bank, soil slopes of 33 percent or flatter that are vegetated would remain intact above the flood stage elevation (18 feet NGVD). Vegetated geosynthetics (e.g., turf mats) can be installed to enhance the vegetation process and protect surface soils from erosion prior to germination. Below the flood stage elevation, soils would remain susceptible to surface erosion from river flow and wave action regardless of slope steepness. In some cases, large boulders and woody debris are used to protect portions of a slope that regularly become inundated with water; however, care must be taken to ensure the slope toe is sufficiently buttressed. Therefore, slope re-grading/re-vegetation has been carried forward in the bank stabilization analysis as a viable technology.

6.2.2 Riprap Armoring

Traditional riprap armoring consists of a blanket of rock material sized to resist river currents and wave action. It is a flexible solution that is able to fit the slope and shape of an existing shoreline. It is also tolerant to changes in subsurface soils due to settlement and other forces. In general, riprap slopes can be maintained at a steeper grade than re-vegetated soil slopes and also provide resistance against surface erosion from water flow. This method is extremely durable in the long-term and provides high resistance to propeller wash and vessel wakes associated with a working waterfront. It is also possible to plant vegetation in the rocks to further stabilize the slope and enhance the slope appearance and habitat.

6.2.3 Articulated Concrete Block Armoring

ACB mats serve as a flexible revetment system that provides resistance to high flow velocities, effective erosion control, and can also be backfilled with topsoil and planted to maintain a natural appearance. ACB mats generally consist of a grid of individual pre-cast concrete blocks that are attached to one another with a web of stainless steel cables. The grids are placed flat across the entire portion of the bank that is subject to erosion. These blocks can be manufactured with open or closed cells. Open-cell ACBs are often planted, and some systems allow for the removal of individual blocks to accommodate larger vegetation. ACB mats are relatively thin, ranging in thickness from 4- to 9-inch blocks, thus resulting in less material placement in comparison to riprap armoring. ACB mats would be a suitable technology.

6.2.4 Geosynthetic Cellular Confinement Systems

Like open-cell ACB systems, geosynthetic CCSs provide an opportunity to combine an engineered slope stabilization technology with native vegetation that enhances habitat and long-term slope stability. CCSs are typically three-dimensional structures made of polyethylene that form open-ended cylinders 3 to 12 inches deep. Each cell acts as a small dam that allows water to pass over the top while holding in place the soil contained inside the cell. Vegetation may be planted in the upper bank cells. In addition to aesthetics, vegetation also helps to reduce the potential for erosion as the plants serve as an anchor. Because the walls may be perforated, roots are allowed to grow through the system, further enhancing the erosion protection. The perforations also allow lateral drainage through the system, enhancing performance of the CCS in submerged conditions. On the lower bank, the cells would be filled with gravel to resist the forces of ship waves and currents and to ensure that return flow is not prohibited.

The CCS option can be implemented in two ways: on a prepared slope to create a stabilized surface that can be vegetated (similar to the ACB application); or in horizontal layers to create a mechanically stabilized earth (MSE) wall with a face that can be vegetated. The existing slopes are on the order of 3:1 (horizontal:vertical), so MSE wall segments should not be required. The slope application of the CCS option would perform similarly to the ACB armoring option and result in a re-vegetated slope above the flood stage elevation. Also like the ACB application, initial grading of the slope would be required to ensure voids were not present below the CCS.

6.3 Evaluation of Stabilization Technologies

The potentially applicable stabilization technologies were evaluated based on the criteria given in Section 4.2. Re-grading and re-vegetation would be used with any of the other stabilization technologies, but re-vegetation is suitable only for the zones above the flood stage. Therefore, the following evaluation focuses on the other stabilization technologies for use below flood stage.

6.3.1 Effectiveness

Each of the stabilization technologies address the root cause of instability and would have relatively low risks of contamination during construction. Although each of the technologies would provide adequate erosion control, riprap would most likely have the greatest lifespan due to its ability to provide long-term resistance against surface erosion from water flow and greater flexibility. In the long-term life of the SCM, CCS has a higher potential to be susceptible to scour and erosion. For these reasons, riprap was deemed to be more effective than ACB and CCS.

6.3.2 Implementability

In terms of ease of construction, riprap and ACB are the simplest to implement and the materials are readily attainable within the vicinity of the project area. The ACB and CCS alternatives provide slightly better re-vegetation opportunities. In-water remedies for adjacent sediment management areas are likely to consist of limited action technologies (such as natural recovery or capping). Each of the technologies would be compatible with these approaches. The work should occur above the OLHW, but some work below the OLHW is possible depending on the final design of the remedy. Riprap already exists throughout the OU2 riverbank, thus making riprap the technology most compatible with existing conditions. Furthermore, given the relatively small size of the source control areas, use of riprap is more feasible than the other technologies. There is not expected to be significant differences between the technologies with respect to permitting or sustainability. For these reasons, riprap was deemed more implementable than the other technologies.

6.3.3 Cost

Based on professional experience in the Portland Harbor area, riprap would cost on the order of $4 per square foot and ACB or CCS would cost on the order of $7 to $15 per square foot.

7.0 Recommended Source Control Measure

Based on the results of this evaluation, the recommended source control measure for the OU2 riverbank soils is riprap armoring and re-grading/re-vegetation. This alternative was selected because it provides a low-cost, long-term erosion control solution; it is highly implementable; and it is compatible with existing conditions and potential in-water remediation. A schematic design for the selected alternative is presented on Figure 5.

8.0 References

Ash Creek, 2010. Source Control Evaluation, Operable Unit 2, Swan Island Upland Facility, April 15, 2010.

Ash Creek, 2011. Source Control Evaluation Addendum, Operable Unit 2, Swan Island Upland Facility, December 27, 2011.

Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency, 2005. Portland Harbor Joint Source Control Strategy, Final, December 2005.

NOTE: Base map prepared from USGS 7.5-minute quadrangles as provided by Topozone. (1990)

0 2,000 4,000

Approximate Scale in Feet

N

Facility Location Map

Source Control Alternative Evaluation
Swan Island Upland Facility Operable Unit 2
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Project Number	1115-05	Figure
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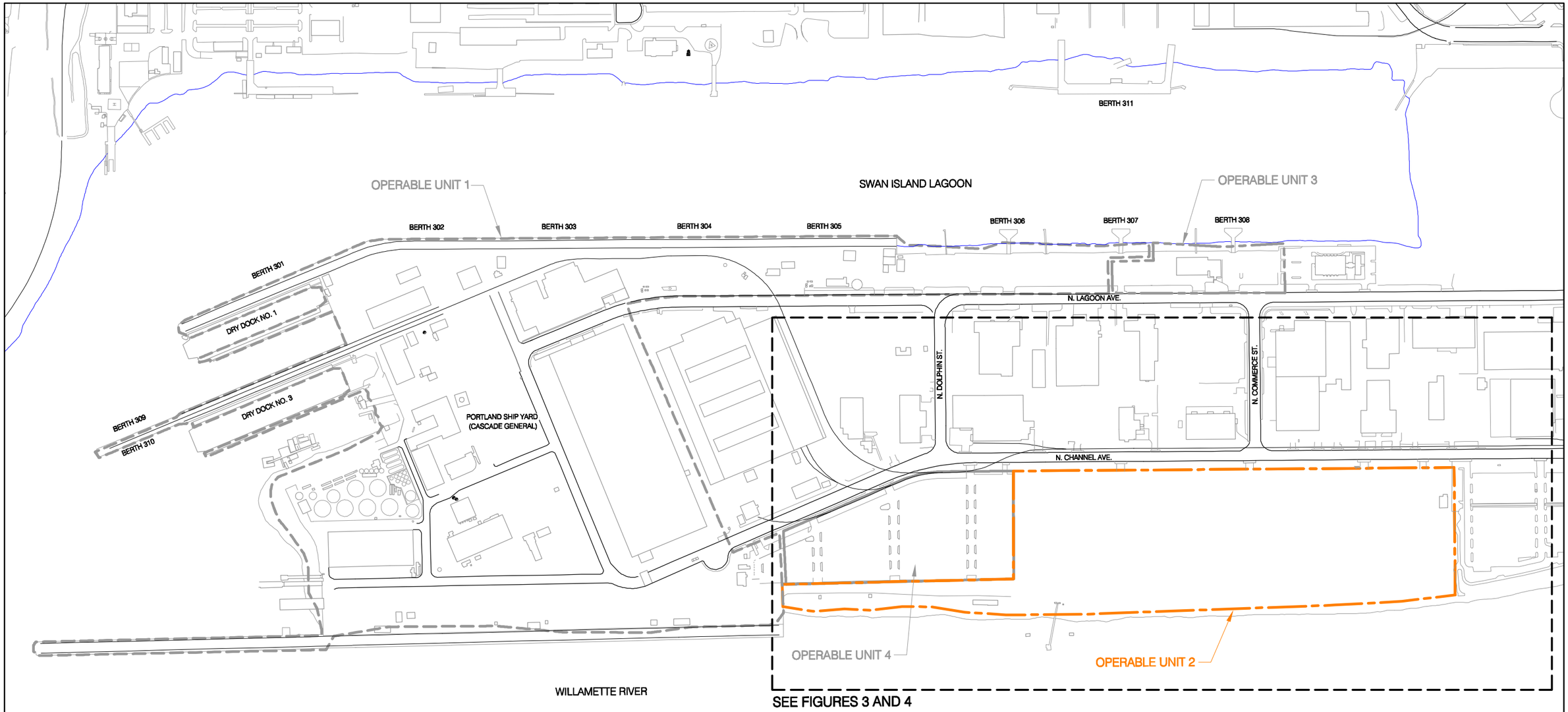

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0 400 800

Scale in Feet

Legend:

- Operable Unit 1 Boundary
- Operable Unit 2 Boundary
- Operable Unit 3 Boundary
- Operable Unit 4 Boundary

NOTE:
1. Prepared from AutoCAD base map received from the Port of Portland in June 2007.

Facility Vicinity Plan

Source Control Alternative Evaluation
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5411
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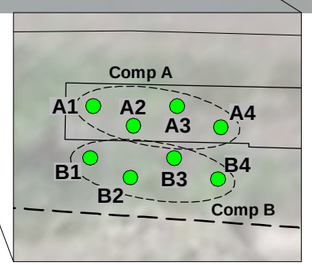
4300-4308, 5115-5169
4300-4308, 5115-5169
5061
5051
5001
3919
4300-4308, 5115-5169
5153
5140
4325
5458
5565
5300, 5350
N. Channel Avenue
5460
OPERABLE UNIT 4
Cemex Leasehold
Daimler Leasehold
82
A: Ship Tie-Down
B: Bare Ground
C: WR-399
D: Bare Ground
E: Depression in Riverbank
F: CG-28 (Inactive)
G: War-Era Substation Platform
Comp A
Comp B
RB-4
RB-15
RB-5
RB-6
CG-26 (Abandoned)
CG-27 (Abandoned)
H: Manway
WR-160
RB-3
RB-14
I: Erosion Scarp
WR-159
RB-2
RB-7
RB-13
RB-12
WR-159a (Abandoned)
J: Erosion Scarp
RB-11
K: Aggregate Conveyor
WR-164
RB-1
L: Erosion Scarp
RB-10
RB-9
M: Erosion Scarp
N: Erosion Scarp
RB-8
O: Depression in Riverbank
P: Erosion Scarp
Q: WR-163
OPERABLE UNIT 2



1" = 50'

Legend:

- A1 — Discrete Sample Location
- Catch Basin
- WR-399 — Outfall Location and Designation
- WR-160 ---------- Storm Water Pipe Location and Designation (Abandoned July 2006)
- RB-8 — Riverbank Soil Sampling Location (RB-8 through RB-15)
- RB-4 — Historical Composite Riverbank Sample Location (RB-1 through RB-7)
- A: Ship Tie-Down — Riverbank Feature Observed During Site Reconnaissance

N

0 200 400

Scale in Feet

NOTES:

1. Prepared from AutoCAD base map received from the Port of Portland in June 2007.
2. Aerial photograph from 2012 - Google Imagery dated August 20, 2011.

OU2 Facility Plan

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4300-4308, 5115-5169
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5051
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4300-4308, 5115-5169
5153
5458
5565
5300, 5350
5140
4325
N. Channel Avenue
5460
OPERABLE UNIT 4
Cemex Leasehold
Daimler Leasehold
82
A: Ship Tie-Down
B: Bare Ground
C: WR-399
D: Bare Ground
E: Depression in Riverbank
F: CG-28 (Inactive)
G: War-Era Substation Platform
Comp A
Comp B
CG-26 (Abandoned)
CG-27 (Abandoned)
H: Manway
I: Erosion Scarp
J: Erosion Scarp
K: Aggregate Conveyor
L: Erosion Scarp
M: Erosion Scarp
N: Erosion Scarp
O: Depression in Riverbank
P: Erosion Scarp
Q: WR-163
WR-159
WR-159a (Abandoned)
WR-160
WR-164
RB-1
RB-2
RB-3
RB-4
RB-5
RB-6
RB-7
RB-8
RB-9
RB-10
RB-11
RB-12
RB-13
RB-14
RB-15
OPERABLE UNIT 2
SOURCE CONTROL MEASURE AREAS

Legend:

- A1 ● Discrete Sample Location
- Catch Basin
- WR-399 Outfall Location and Designation
- WR-160 ---------- Storm Water Pipe Location and Designation (Abandoned July 2006)
- RB-8 Riverbank Soil Sampling Location (RB-8 through RB-15)
- RB-4 Historical Composite Riverbank Sample Location (RB-1 through RB-7)
- A: Ship Tie-Down Riverbank Feature Observed During Site Reconnaissance

N

0 200 400

Scale in Feet

NOTES:

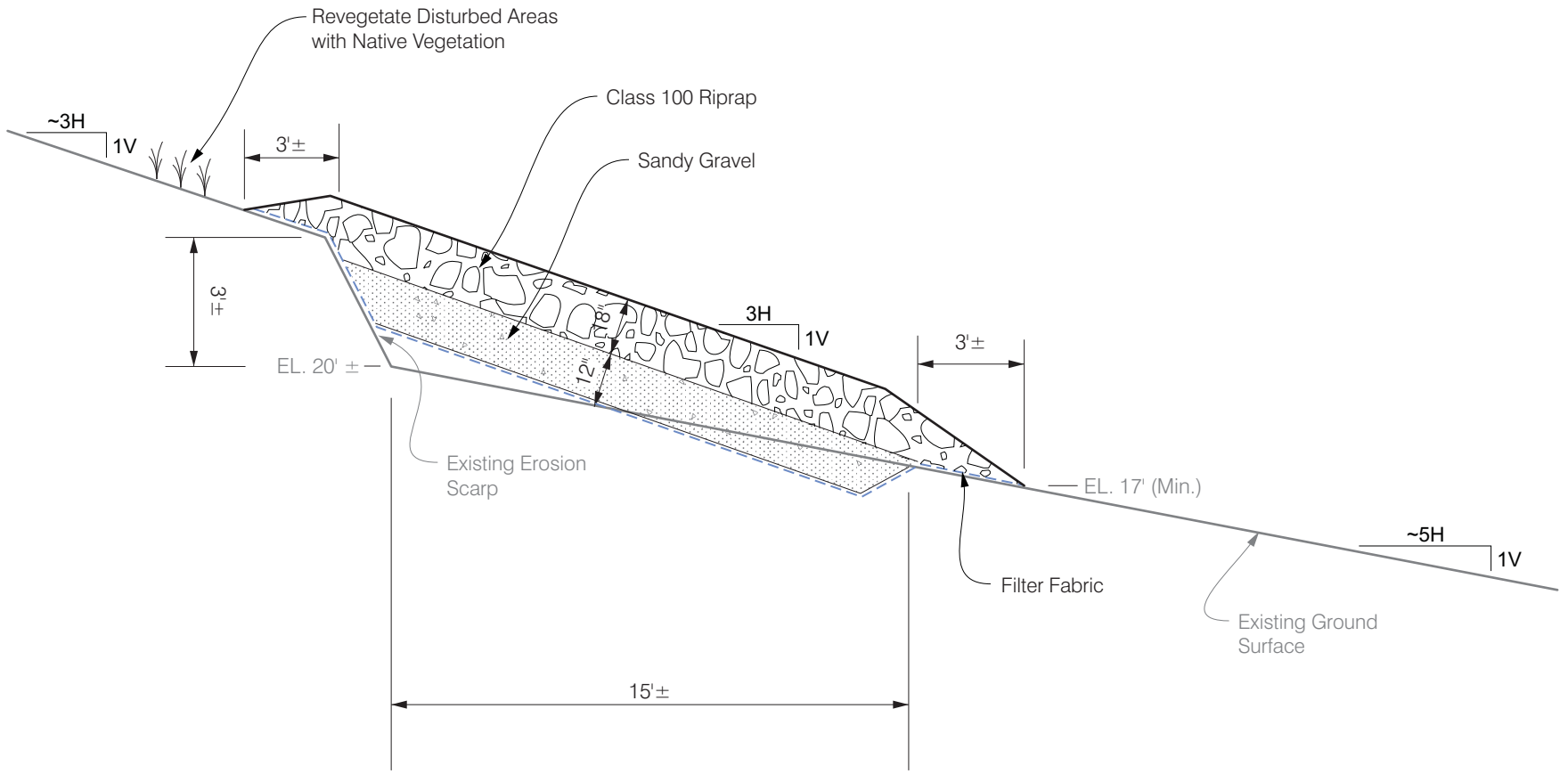
1. Prepared from AutoCAD base map received from the Port of Portland in June 2007.
2. Aerial photograph from 2012 - Google Imagery dated August 20, 2011.

Source Control Measure Areas

Source Control Alternative Evaluation
Swan Island Upland Facility Operable Unit 2
Portland, Oregon

Ash Creek Associates
A Division of Apex Companies, LLC
APEX

Project Number	1115-05	Figure
May 2012		4



NOTES:

1) Not to Scale
2) Balance Cut/Fill for Subgrade Preparation
3) Elevations NGVD47

Proposed Source Control Schematic

Source Control Alternative Evaluation
Swan Island Upland Facility Operable Unit 2
Portland, Oregon

Ash Creek Associates
A Division of Apex Companies, LLC
APEX

Project Number	1115-05	Figure
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Appendix A

Data Tables and Supporting Calculations

Appendix A — Data Tables and Supporting Calculations

This appendix presents the data and calculations for development of the source control measure areas for metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

1. The riverbank soil data for metals, PAHs, and PCBs are summarized in Tables A-1 through A-3.
2. The PAH BaPEq concentration was calculated using EPA toxicity equivalent values shown in Table A-2. Only detected PAHs were included in the BaPEq calculation.
3. The 90-percent upper confidence limit of the mean (90UCL) values were calculated for each data set using the following approach.
    a. Discrete samples between top of bank and ordinary line of high water (OLHW) were included. Table A-4 shows the ground surface elevation at the sample locations.
    b. Composite samples were generally included because the area represented by each composite was small relative to the overall area of the riverbank, except that composite samples were not included when:
        i. A majority of the composite subsamples were collected below the OLHW; or
        ii. The composite subsamples were individually analyzed (and were therefore already included in the dataset).
    c. EPA ProUCL software was used.
    d. When PCBs were not detected, the highest individual Aroclor detection limit was used for the total PCBs detection limit.
    e. 90UCL input data sets are included in Tables A-5 through A-7.
    f. Output data sets are included in Table A-8.
    g. The following lists the 90UCL calculated for each chemical detected above Joint Source Control screening level values (SLVs) together with the Source Control Goal (SCG) for the OU2 riverbank.

Source Control Potential Chemical of Concern	90UCL	SCG
Arsenic (mg/kg)	9.6	17
Cadmium (mg/kg)	0.35	3.5
Copper (mg/kg)	515	149
Lead (mg/kg)	94	91
Zinc (mg/kg)	308	315
BaPEq (µg/kg)	318	423
PCBs (µg/kg)	172	29.5

4. Copper, lead, and PCBs are present in the riverbank soils at concentrations resulting in the 90UCL above the corresponding SCGs so these are the source control chemicals of concern (COCs).
5. Potential source control action levels were evaluated for each source control COC using the following approach.
    a. The data sets from the above 90UCL calculations (Tables A-5 through A-7) were the starting data set for the action level calculations.
    b. EPA ProUCL software was used.
    c. The data were sorted in descending order and 90UCLs were successively calculated by sequentially removing the highest relative concentration. This was repeated until the 90UCL was below the SCG.
    d. 90UCL input data sets are presented in Tables A-9 through A-11.
    e. Output data sets for the action level calculations are included in Tables A-12 through A-14.
    f. The following lists the results of the action level calculations.

Copper		
Max. Conc. mg/kg	Sample No.	90UCL mg/kg
1640	RB-10b	515
567	RB-13b	198
298	RB-9a	154
284	RB-9b	136

Lead		
Max. Conc. mg/kg	Sample No.	90UCL mg/kg
439	RB-10b	94
225	RB-9a	63

PCBs		
Max. Conc. µg/kg	Sample No.	90UCL mg/kg
613	RB-10b	172
156	RB-9b	61
154	RB-9a	53
110*	RB-3	43
77.3	RB-10a	43
77	RB-2	40
72	RB-1	36
71.1	RB-14b	31
58	RB-11b	24

*Not detected at a detection limit of 110 µg/kg.

6. The following lists the calculated source control action levels:
    a. Copper – 290 mg/kg
    b. Lead – 410 mg/kg
    c. Total PCBs – 68 µg/kg

7. The following lists the samples above the source control action levels with the associated identified erosion feature.

Copper	
Sample No.	Erosion Feature
RB-10b	L
RB-13b	J
RB-9a	M

Lead	
Sample No.	Erosion Feature
RB-10b	L

PCBs	
Sample No.	Erosion Feature
RB-10b	L
RB-9b	M
RB-9a	M
RB-3*	I
RB-10a	L
RB-2	J
RB-1	None
RB-14b	I

*Not detected at a detection limit of 110 µg/kg.

8. Practicability (i.e., cost vs. benefit) of addressing each of the identified erosion features was evaluated using the following process.
    a. It was assumed that cost of a source control would be proportional to length of the erosion feature. Therefore, length of the erosion feature can be used as a surrogate for cost.
    b. Benefit was assumed to be represented by the reduction in the 90UCL as a percentage of the difference between the pre-source control 90UCL and the source control action level.
    c. Calculations of "cost" and "benefit" are presented in Tables A-15 through A-17.
    d. Plots of "cost vs. "benefit" are presented on Figures A-1 and A-2 for copper and total PCBs, respectively (lead requires source control on only a single feature – feature L – to achieve the SCG).
    e. The break in the curve corresponds to the point beyond which the additional cost is disproportionate to the additional benefit. Control of feature L for copper and features L and M for total PCBs are practicable based on the cost-benefit analysis.
9. The 90UCL concentration was calculated for each source control COC assuming a source control action at features L and M using the following procedure.
    a. Started with database from Step 3 above.
    b. Sample results for RB-9a and RB9b (feature M) and RB-10a and RB-10b (feature L) were removed from the database.
    c. EPA ProUCL software was used.

d. 90UCL input data sets are presented in Table A-18.
e. Output data sets for the post-source control simulation calculations are included in Table A-19.
f. Results are listed below.

Source Control Potential Chemical of Concern	90UCL	SCG
Copper (mg/kg)	181	149
Lead (mg/kg)	43	91
PCBs (µg/kg)	39	29.5

10. Based on the following weight-of-evidence evaluation, source control at features L and M is protective of sediments in the Willamette River.
    a. The total area of bare ground on the riverbank potentially subject to erosion represents less than 2 percent of the total bank area (see Ash Creek, 2011 for dimensions of bare ground features on the riverbank). The remainder of the bank is covered with dense vegetation or rip rap with no visible indications of erosion.
    b. Copper is not a contaminant of concern in the sediments adjacent to OU2.
    c. Storm water does not flow from upland over the riverbank.
    d. Potential for bank erosion is limited to conditions when river levels are at or above 15 feet NGVD. The river exceeds this elevation less than 20 percent of the time.
    e. The 90 UCL concentrations shown in 9.f above exceed the SCGs by only 20 to 30 percent. These differences are small relative to uncertainties in attenuation with transport to the river and mixing with sediments incoming to the harbor.

Table A-1 - Riverbank Soil Analytical Results: Metals (mg/kg)
SIUF - OU2
Portland, Oregon

	2006 Sampling			2008 Sampling							
Outfall Pipe ID:	WR-164	WR-159	WR-160	WR-399	WR-399	WR-399	WR-399	CG-26	CG-26	CG-26	CG-26	
Sample ID:	RB-1 Composite	RB-2 Composite	RB-3 Composite	RB-4 Composite	RB-4a	RB-4b	RB-4c	RB-5 Composite	RB-5a	RB-5b	RB-5c	JSCS
Sample Date:	9/26/2006	9/26/2006	9/26/2006	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	SLV
Metals (mg/kg)												
Antimony	0.93	0.4	0.35	0.35	--	--	--	0.37	--	--	--	64
Arsenic	12.2	3.8	7	3.4	--	--	--	2.7	--	--	--	7
Cadmium	1.04	0.46	0.48	0.238	--	--	--	0.763	--	--	--	1
Chromium	29	19.9	22	13.6	--	--	--	13.8	--	--	--	111
Copper	271	92.4	96.3	65.9	--	--	--	33.3	--	--	--	149
Lead	85.6	43.2	36	41.3	27.2	170	91.4	20.1	30.1	15.2	6.94	17
Nickel	26.8	16.9	20.3	15.0	--	--	--	17.9	--	--	--	48.6
Silver	0.19	0.09	0.14	0.05	--	--	--	0.04	--	--	--	5
Zinc	835	174	264	153	--	--	--	246	--	--	--	459

	2008 Sampling								
Outfall Pipe ID:	CG-27	CG-27	CG-27	CG-27	WR-159a	WR-159a	WR-159a	WR-159a	
Sample ID:	RB-6 Composite	RB-6a	RB-6b	RB-6c	RB-7 Composite	RB-7a	RB-7b	RB-7c	JSCS
Sample Date:	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	10/1/2008	SLV
Metals (mg/kg)									
Antimony	0.27	--	--	--	0.63	--	--	--	64
Arsenic	3.1	--	--	--	2.9	--	--	--	7
Cadmium	1.11	--	--	--	0.189	--	--	--	1
Chromium	14.9	--	--	--	22.9	--	--	--	111
Copper	57.7	--	--	--	71.3	--	--	--	149
Lead	42.6	58.2	87.5	33.6	57.5	84.2	104	18.5	17
Nickel	16.6	--	--	--	24.6	--	--	--	48.6
Silver	0.06	--	--	--	0.07	--	--	--	5
Zinc	359	--	--	--	121	--	--	--	459

Please refer to notes at end of table.

Table A-1 - Riverbank Soil Analytical Results: Metals (mg/kg)
SIUF - OU2
Portland, Oregon

	2011 Sampling																
Sample ID:	RB-8a	RB-8b	RB-9a	RB-9b	RB-10a	RB-10b	RB-11a	RB-11b	RB-12a	RB-12b	RB-13a	RB-13b	RB-14a	RB-14b	RB-15a	RB-15b	JSCS
Sample Date:	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	SLV
Metals (mg/kg)																	
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	64
Arsenic	24.6	3.7	7.0	6.7	5.3	24.1	3.7	4.1	4.0	3.0	2.2	2.0	5.4	5.9	4.2	7.0	7
Cadmium	0.41	0.084	0.20	0.16	0.13	0.46	0.13	0.10	0.19	0.082	0.089	0.10	0.22	0.21	0.15	0.29	1
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	111
Copper	112	60.1	298	284	112	1,640	57.2	125	61.4	42.4	25.8	567	46.7	62.5	50.7	103	149
Lead	77.6	21.4	225	78.2	35.0	439	23.2	42.6	24.6	17.1	7.4	12.0	15.4	51.3	14.1	53.3	17
Nickel	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	48.6
Silver	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5
Zinc	428	98.0	206	187	110	708	116	107	127	65.4	42.3	77.2	114	118	83.1	129	459

Notes:

1. Metals analysis by EPA 6000/7000 Series Methods.
2. mg/kg = Milligrams per kilogram (parts per million).
3. JSCS SLV = Portland Harbor Joint Source Control Strategy Table 3-1: Screening Level Values for Soil/Storm Water Sediment (7/16/07 Revision)
4. Shading indicates that the reported concentration exceeds the screening level.
5. -- = Not analyzed or not available.

Table A-2 - Riverbank Soil Analytical Results: Riverbank Polycyclic Aromatic Hydrocarbons (ug/kg)
SIUF - OU2
Portland, Oregon

	2006 Sampling													
Outfall Pipe ID:	WR-164	WR-164	WR-164	WR-164	WR-159	WR-159	WR-159	WR-159	WR-160	WR-160	WR-160	WR-160		
Sample ID:	RB-1 Composite	RB-1a	RB-1b	RB-1c	RB-2 Composite	RB-2a	RB-2b	RB-2c	RB-3 Composite	RB-3a	RB-3b	RB-3c	Toxicity Equivalency to Benzo(a)pyrene	JSCS SLV
Sample Date:	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006		
PAHs (µg/kg)														
Acenaphthene	<2.7	3.1	<2.7	2.9	5.1	<2.6	11	3.5	<2.8	<2.6	<2.8	17	--	300
Acenaphthylene	41	28	34	28	61	19	84	33	16	15	8.8	23	--	200
Anthracene	14	12	13	14	24	7.2	41	16	9.1	9	5.5	49	--	845
Benz(a)anthracene	68	61	69	63	140	50	230	110	45	36	40	110	0.1	1,050
Benzo(a)pyrene	170	140	180	150	320	130	520	230	94	79	64	180	1	1,450
Benzo(b)fluoranthene	210	140	220	180	310	110	520	230	87	76	69	170	0.1	--
Benzo(g,h,i)perylene	360	260	330	260	490	180	720	330	150	130	87	190	--	300
Benzo(k)fluoranthene	160	110	140	120	240	85	380	160	70	61	57	110	0.01	13,000
Chrysene	160	120	160	140	260	95	430	190	82	69	62	210	0.001	1,290
Dibenz(a,h)anthracene	22	21	30	25	34	15	77	36	11	14	14	35	1	1,300
Dibenzofuran	<2.7	2.9	<2.7	2.7	3.3	<2.6	6.6	3.4	<2.8	4.3	<2.8	7.1	--	--
Fluoranthene	160	150	150	150	330	120	500	230	100	93	59	210	--	2,230
Fluorene	<2.7	<2.8	<2.7	2.6	4.8	<2.6	9.2	2.8	<2.8	<2.6	<2.8	15	--	536
Indeno(1,2,3-cd)pyrene	290	210	270	210	430	150	660	270	120	110	80	160	0.1	100
1-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	
2-Methylnaphthalene	4	5.6	4	3.6	5.4	<2.6	11	5.4	3.5	4.8	<2.8	12	--	200
Naphthalene	7.9	11	7.4	6.9	9.7	4.5	19	10	6.3	6.8	3.5	13	--	561
Phenanthrene	37	46	33	42	92	22	150	58	31	36	17	190	--	1,170
Pyrene	220	220	240	200	430	170	690	350	130	120	83	290	--	1,520
BaPEq	251	203	267	222	445	177	742	329	131	116	98	260		

Table A-2 - Riverbank Soil Analytical Results: Riverbank Polycyclic Aromatic Hydrocarbons (ug/kg)
SIUF - OU2
Portland, Oregon

	2008 Sampling					
Outfall Pipe ID:	WR-399	CG-26	CG-27	WR-159a		
Sample ID:	RB-4	RB-5	RB-6	RB-7	Toxicity Equivalency to	JSCS
Sample Date:	Composite 10/1/2008	Composite 10/1/2008	Composite 10/1/2008	Composite 10/1/2008	Benzo(a)pyren	SLV
PAHs (µg/kg)						
Acenaphthene	8.9	0.87 J	1.2 J	0.69 J	--	300
Acenaphthylene	1.8 J	2.2 J	2.0 J	4.1 J	--	200
Anthracene	9.3	3.5 J	2.2 J	4.5 J	--	845
Benz(a)anthracene	45	23	17	22	0.1	1,050
Benzo(a)pyrene	70	42	29	43	1	1,450
Benzo(b)fluoranthene	100	61	35	49	0.1	--
Benzo(g,h,i)perylene	81	64	33	70	--	300
Benzo(k)fluoranthene	33	15	12	17	0.01	13,000
Chrysene	79	27	26	35	0.001	1,290
Dibenz(a,h)anthracene	15	21	5.7	12	1	1,300
Dibenzofuran	10	5.6	0.99 J	1.1 J	--	--
Fluoranthene	120	32	34	38	--	2,230
Fluorene	7.6	0.68 J	0.93 J	0.91 J	--	536
Indeno(1,2,3-cd)pyrene	77	46	30	56	0.1	100
1-Methylnaphthalene	--	--	--	--	--	
2-Methylnaphthalene	6.4	23	2.1 J	2.7 J	--	200
Naphthalene	9.2	23	5.6	8.2	--	561
Phenanthrene	87	20	15	16	--	1,170
Pyrene	120	46	38	52	--	1,520
BaPEq	108	76	43	68		

Table A-2 - Riverbank Soil Analytical Results: Riverbank Polycyclic Aromatic Hydrocarbons (ug/kg)
SIUF - OU2
Portland, Oregon

	2011 Sampling																	
Sample ID:	RB-8a	RB-8b	RB-9a	RB-9b	RB-10a	RB-10b	RB-11a	RB-11b	RB-12a	RB-12b	RB-13a	RB-13b	RB-14a	RB-14b	RB-15a	RB-15b	Toxicity Equivalency	JSCS
Sample Date:	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	to Benzo(a)pyrene	SLV
PAHs (µg/kg)																		
Acenaphthene	5.8 J	<1.2	10.6	6.1 J	<1.2	155	2.3 J	2.1 J	2.0 J	<1.2	<1.2	<1.2	1.5 J	2.1 J	34.4	50.2	--	300
Acenaphthylene	95	3.8 J	14.9	18.7	5.9 J	183	6.3 J	10.0	4.3 J	7.2	<1.2	2.2 J	3.7 J	13.8	47.1	76.2	--	200
Anthracene	48.4	4.5 J	36.7	45.8	8.5	1,690	10.9	8.7	6.6 J	6.2 J	<1.2	2.0 J	6.0 J	23.6	36.1	94.5	--	845
Benz(a)anthracene	133	14.4	111	106	37.9	705	29.5	32.2	21.8	29.7	1.1	7.2	19.2	70.4	64.5	106	0.1	1,050
Benzo(a)pyrene	293	22.1	127	142	51.6	783	40.4	54.7	35.3	40.4	1.3	10.0	21.8	80.5	72.4	109	1	1,450
Benzo(b)fluoranthene	339	30.8	181	179	70.0	1,140	61.7	80.5	51.4	53.6	1.6	13.2	36.0	87.4	68.9	120	0.1	--
Benzo(g,h,i)perylene	368	24.5	118	154	47.5	1,020	43.4	76.4	34.8	38.7	2.1	12.0	19.9	61.0	50.1	105	--	300
Benzo(k)fluoranthene	97.7	10.3	56.4	71.3	26.2	409	17.4	28.5	15.9	18.6	1.2	4.5	13.1	32.4	29.8	44.3	0.01	13,000
Chrysene	194	18.4	108	109	41.5	667	37.5	41.6	28.7	32.1	1.3	8.5	29.0	71.1	62.8	133	0.001	1,290
Dibenz(a,h)anthracene	42.8	5.3	33.2	34.5	13.6	236	10.3	20.9	7.8	10.3	0.9	2.3	4.3	14.3	10.3	12.7	1	1,300
Dibenzofuran	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	358	23.2	175	158	54.4	1,640	49.5	39.2	44.1	27.9	1.5	10.2	35.1	100	129	243	--	2,230
Fluorene	7.1	<1.5	12.7	10.2	1.6 J	246	4.4 J	2.4 J	2.1 J	1.8 J	1.5	<1.5	2.2 J	4.7 J	25.5	81.0	--	536
Indeno(1,2,3-cd)pyrene	321	25.0	128	150	52.1	1,130	44.5	78.0	36.5	40.6	1.4	11.1	20.1	59.0	49.5	84.4	0.1	100
1-Methylnaphthalene	3.1 J	<1.3	6.6 J	4.1 J	1.5 J	36.6	1.4 J	2.1 J	<1.4	<1.3	<1.3	<1.3	2.0 J	2.7 J	33.8	46.3	--	--
2-Methylnaphthalene	5.0 J	<1.3	12.1	7.8	1.3 J	93.1	2.5 J	2.0 J	2.2 J	2.1 J	<1.3	<1.3	3.7 J	4.7 J	62.1	98.4	--	200
Naphthalene	7.9	<2.8	21.8	12.5	<2.7	124	<2.8	2.8 J	4.0 J	<2.8	<2.8	<2.8	6.9 J	6.1 J	256	313	--	561
Phenanthrene	131	7.8	95.5	62.4	15.9	1,060	24.6	20.2	21.2	11.5	<1.2	4.2 J	22.2	47.6	145	339	--	1,170
Pyrene	411	24.9	149	146	48.9	1,460	47.4	43.3	38.3	33.4	1.6 J	11.8	33.2	2.0 J	150	449	--	1,520
BaPEq	416	35	203	221	82	1321	64	95	54	63	3	16	34	117	101	153		

Notes:

1. Polycyclic Aromatic Hydrocarbons (PAHs) by U.S. Environmental Protection Agency (EPA) Method 8270-SIM.
2. µg/kg = Micrograms per kilogram (parts per billion).
3. JSCS SLV = Portland Harbor Joint Source Control Strategy Table 3-1: Screening Level Values for Soil/Storm Water Sediment (7/16/07 Revision).
4. -- = Not analyzed or not available.
5. < = Not detected above the Method Reporting Limit (MRL).
6. Shading indicates that the reported concentration exceeds the screening level.
7. J = The result is an estimated concentration that is less than the MRL but greater than or equal to the Method Detection Limit (MDL).
8. PaPEQ = Benzo(a)pyrene equivalent.

Table A-3 - Riverbank Soil Analytical Results: Riverbank Polychlorinated Biphenyls (ug/kg)
SIUF - OU2
Portland, Oregon

	2006 Sampling			2008 Sampling				
Outfall Pipe ID:	WR-164	WR-159	WR-160	WR-399	CG-26	CG-27	WR-159a	
Sample ID:	RB-1	RB-2	RB-3	RB-4	RB-5	RB-6	RB-7	
	Composite	Composite	Composite	Composite	Composite	Composite	Composite	JSCS
Sample Date:	9/26/2006	9/26/2006	9/26/2006	10/1/2008	10/1/2008	10/1/2008	10/1/2008	SLV
PCBs (µg/kg)								
Aroclor 1016	<54	<52	<55	<10	<10	<10	<10	530
Aroclor 1221	<110	<110	<110	<20	<20 i	<20 i	<20	--
Aroclor 1232	<54	<52	<55	<10	<10 i	<10 i	<10	--
Aroclor 1242	<54	<52	<55	<10	<10 i	<10	<10	--
Aroclor 1248	<54	<52	<55	<10	<10 i	<10 i	<10	1,500
Aroclor 1254	<54	<52	<55	23	<10	<10	14 P	300
Aroclor 1260	72	77	<55	68	53	78	44	200
Aroclor 1262	--	--	--	<10	<10	<10	<10	--
Aroclor 1268	--	--	--	<10	<10	<10	<10	--
Total PCBs	72	77	<110	91	53	78	58	0.39

	2011 Sampling															
Sample ID:	RB-8a	RB-8b	RB-9a	RB-9b	RB-10a	RB-10b	RB-11a	RB-11b	RB-12a	RB-12b	RB-13a	RB-13b	RB-14a	RB-14b	RB-15a	RB-15b	JSCS
Sample Date:	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	10/6/2011	SLV
PCBs (µg/kg)																	
Aroclor 1016	<5.0	<5.1	<5.1	<5.2	<5.1	<4.9	<5.2	<5.0	<5.6	<5.0	<5.1	<5.1	<5.7	<5.4	<7.3	<7.2	530
Aroclor 1221	<2.5	<2.6	<2.5	<2.6	<2.6	<2.4	<2.6	<2.5	<2.8	<2.5	<2.6	<2.5	<2.8	<2.7	<3.6	<3.6	--
Aroclor 1232	<3.5	<3.6	<3.5	<3.6	<3.6	<3.4	<3.6	<3.5	<3.9	<3.5	<3.6	<3.5	<4.0	<3.8	<5.1	<5.0	--
Aroclor 1242	<4.6	<4.7	<4.7	<4.8	<4.7	<4.5	<4.8	<4.6	<5.2	<4.7	<4.7	<4.7	<5.2	<5.0	<6.7	<6.6	--
Aroclor 1248	<4.4	<4.5	<4.5	<4.5	<4.5	<4.3	<4.6	<4.4	<4.9	<4.4	<4.5	<4.5	<5.0	<4.8	<6.4	<6.3	1,500
Aroclor 1254	<2.7	<2.7	<2.7	<2.8	<2.7	<2.6	<2.8	<2.7	<3.0	<2.7	<2.7	<2.7	<3.0	<2.9	<3.9	<3.8	300
Aroclor 1260	26.4	12.6 J	154	156	77.3	613	<5.5	58.0	10.3 J	25.7	<5.5	7.8 J	9.8 J	71.1	<7.8	<7.7	200
Aroclor 1262	<3.1	<3.2	<3.2	<3.2	<3.2	<3.1	<3.2	<3.1	<3.5	<3.2	<3.2	<3.2	<3.6	<3.4	<4.6	<4.5	--
Aroclor 1268	<1.4	<1.5	<1.5	<1.5	<1.5	<1.4	<1.5	<1.4	<1.6	<1.5	<1.5	<1.5	<1.6	<1.6	<2.1	<2.1	--
Total PCBs	26.4	12.6 J	154	156	77.3	613	<5.5	58	10.3 J	25.7	<5.5	7.8 J	9.8 J	71.1	<7.8	<7.7	0.39

	2011 Sampling		
	Sub A - 2011	Sub A - 2011 -	
Sample ID:	(Comp A)	(Comp B)	JSCS
Sample Date:	2/16/2011	2/16/2011	SLV
PCBs (µg/kg)			
Aroclor 1016	<5.5	<5.8	530
Aroclor 1221	<2.8	<2.9	--
Aroclor 1232	<3.8	<4.0	--
Aroclor 1242	<5.1	<5.3	--
Aroclor 1248	<4.9	<5.1	1,500
Aroclor 1254	<2.9	<3.1	300
Aroclor 1260	24.8	<6.2	200
Aroclor 1262	<3.5	<3.6	--
Aroclor 1268	<1.6	<1.7	--
Total PCBs	24.8	<6.2	0.39

Notes:

1. Polychlorinated Biphenyl (PCB) Aroclors by U.S. Environmental Protection Agency (EPA) Method 8082.
2. µg/kg = Micrograms per kilogram (parts per billion).
3. JSCS SLV = Portland Harbor Joint Source Control Strategy Table 3-1: Screening Level Values for Soil/Storm Water Sediment (7/16/07 Revision).
4. -- = Not analyzed or not available.
5. < = Not detected above the Method Reporting Limit (MRL).
6. Shading indicates that the reported concentration exceeds the screening level.
7. Total PCBs = Sum of the detected Aroclors or the highest detection limit when not detected.
8. i = The MRL/Method Detection Limit (MDL) has been elevated due to chromatic interference.
9. P = The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40 percent between the two analytical results.
10. J = Estimated.

Table A-4 - Elevation of Riverbank Soil Samples
SIUF - OU2
Portland, Oregon

Sample ID	Sample Date	Approximate Ground Elevation (ft NGVD 47)
RB-1a	9/26/2006	30
RB-1b	9/26/2006	18
RB-1c	9/26/2006	5
RB-1 Composite	9/27/2006	18
RB-2a	9/26/2006	30
RB-2b	9/26/2006	18
RB-2c	9/26/2006	5
RB-2 Composite		18
RB-3a	9/26/2006	30
RB-3b	9/26/2006	18
RB-3c	9/26/2006	5
RB-3 Composite		18
RB-4a	10/1/2008	17
RB-4b	10/1/2008	10
RB-4c	10/1/2008	3
RB-4 Composite		10
RB-5a	10/1/2008	17
RB-5b	10/1/2008	10
RB-5c	10/1/2008	3
RB-5 Composite		10
RB-6a	10/1/2008	17
RB-6b	10/1/2008	10
RB-6c	10/1/2008	3
RB-6 Composite		10
RB-7a	10/1/2008	14
RB-7b	10/1/2008	8
RB-7c	10/1/2008	3
RB-7 Composite		8
RB-8a	10/6/2011	24
RB-8b	10/6/2011	24
RB-9a	10/6/2011	23
RB-9b	10/6/2011	22
RB-10a	10/6/2011	23
RB-10b	10/6/2011	21
RB-11a	10/6/2011	22
RB-11b	10/6/2011	19
RB-12a	10/6/2011	22
RB-12b	10/6/2011	17
RB-13a	10/6/2011	21
RB-13b	10/6/2011	19
RB-14a	10/6/2011	17
RB-14b	10/6/2011	17
RB-15a	10/6/2011	10
RB-15b	10/6/2011	9

OLHW = 16.6 ft

Table A-5 - Riverbank Soil Analytical Results: Metals 90UCL Input Data
SIUF - OU2
Portland, Oregon

Sample ID	Arsenic (mg/kg)	Sample ID	Cadmium (mg/kg)	Sample ID	Copper (mg/kg)	Sample ID	Lead (mg/kg)	Sample ID	Zinc (mg/kg)
RB-1 Composite	12.2	RB-1	1.04	RB-1	271	RB-1	85.6	RB-1	835
RB-2 Composite	3.8	RB-2	0.46	RB-2	92.4	RB-2	43.2	RB-2	174
RB-3 Composite	7	RB-3	0.48	RB-3	96.3	RB-3	36	RB-3	264
RB-8a	24.6	RB-8a	0.41	RB-8a	112	RB-4a	27.2	RB-8a	428
RB-8b	3.7	RB-8b	0.084	RB-8b	60.1	RB-5a	30.1	RB-8b	98.0
RB-9a	7.0	RB-9a	0.20	RB-9a	298	RB-6a	58.2	RB-9a	206
RB-9b	6.7	RB-9b	0.16	RB-9b	284	RB-8a	77.6	RB-9b	187
RB-10a	5.3	RB-10a	0.13	RB-10a	112	RB-8b	21.4	RB-10a	110
RB-10b	24.1	RB-10b	0.46	RB-10b	1,640	RB-9a	225	RB-10b	708
RB-11a	3.7	RB-11a	0.13	RB-11a	57.2	RB-9b	78.2	RB-11a	116
RB-11b	4.1	RB-11b	0.10	RB-11b	125	RB-10a	35.0	RB-11b	107
RB-12a	4.0	RB-12a	0.19	RB-12a	61.4	RB-10b	439	RB-12a	127
RB-12b	3.0	RB-12b	0.082	RB-12b	42.4	RB-11a	23.2	RB-12b	65.4
RB-13a	2.2	RB-13a	0.089	RB-13a	25.8	RB-11b	42.6	RB-13a	42.3
RB-13b	2.0	RB-13b	0.10	RB-13b	567	RB-12a	24.6	RB-13b	77.2
RB-14a	5.4	RB-14a	0.22	RB-14a	46.7	RB-12b	17.1	RB-14a	114
RB-14b	5.9	RB-14b	0.21	RB-14b	62.5	RB-13a	7.4	RB-14b	118
						RB-13b	12.0		
						RB-14a	15.4		
						RB-14b	51.3		

Notes:

1. Metals from Table A-1.
2. mg/kg = Milligrams per kilogram (parts per million).
3. 90UCL = 90-percent upper confidence limit of the mean
4. Includes data above ordinary line of high water

Table A-6 - Riverbank Soil Analytical Results: PAHs 90UCL Input Data
SIUF - OU2
Portland, Oregon

Sample ID:	BaP Equiv (µg/kg)
RB-1a	203
RB-1b	267
RB-2a	177
RB-2b	742
RB-3a	116
RB-3b	98
RB-8a	416
RB-8b	35
RB-9a	203
RB-9b	221
RB-10a	82
RB-10b	1321
RB-11a	64
RB-11b	95
RB-12a	54
RB-12b	63
RB-13a	3
RB-13b	16
RB-14a	34
RB-14b	117

Notes:

1. Polycyclic Aromatic Hydrocarbons (PAHs) from Table A-2.
2. µg/kg = Micrograms per kilogram (parts per billion).
3. 90UCL = 90-percent upper confidence limit of the mean
4. Includes data above ordinary line of high water

Table A-7 - Riverbank Soil Analytical Results: PCBs 90UCL Input Data
SIUF - OU2
Portland, Oregon

Sample ID:	Total PCBs (µg/kg)
RB-1 Composite	72
RB-2 Composite	77
RB-3 Composite	<110
Sub A - 2011 (Comp A)	24.8
Sub A - 2011 - (Comp B)	<6.2
RB-8a	26.4
RB-8b	12.6
RB-9a	154
RB-9b	156
RB-10a	77.3
RB-10b	613
RB-11a	<5.5
RB-11b	58
RB-12a	10.3
RB-12b	25.7
RB-13a	<5.5
RB-13b	7.8
RB-14a	9.8
RB-14b	71.1

Notes:

1. Polychlorinated Biphenyls (PCBs) from Table A-3.
2. µg/kg = Micrograms per kilogram (parts per billion).
3. Total PCBs = Sum of the detected Aroclors or the highest detection limit when not detected

Table A-8 - Riverbank Soil Data 90UCL Output
SIUF - OU2
Portland, Oregon

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

As (mg/kg) - 24.6

General Statistics			
Number of Valid Observations	17	Number of Distinct Observations	15
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	24.6	Maximum of Log Data	3.203
Mean	7.335	Mean of log Data	1.714
Median	5.3	SD of log Data	0.711
SD	6.835		
Std. Error of Mean	1.658		
Coefficient of Variation	0.932		
Skewness	2.079		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.671	Shapiro Wilk Test Statistic	0.909
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	9.551	90% H-UCL	9.628
		90% Chebyshev (MVUE) UCL	10.88
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	12.62
90% Adjusted-CLT UCL (Chen-1995)	10.06	97.5% Chebyshev (MVUE) UCL	15.05
90% Modified-t UCL (Johnson-1978)	9.691	99% Chebyshev (MVUE) UCL	19.81
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.64	Data appear Lognormal at 5% Significance Level	
Theta Star	4.471		
MLE of Mean	7.335		
MLE of Standard Deviation	5.727		
nu star	55.78		
Approximate Chi Square Value (.05)	42.74	Nonparametric Statistics	
Adjusted Level of Significance	0.0823	90% CLT UCL	9.46
Adjusted Chi Square Value	41.79	90% Jackknife UCL	9.551
		90% Standard Bootstrap UCL	9.423
Anderson-Darling Test Statistic	1.114	90% Bootstrap-t UCL	11.37
Anderson-Darling 5% Critical Value	0.75	90% Hall's Bootstrap UCL	13.49
Kolmogorov-Smirnov Test Statistic	0.253	90% Percentile Bootstrap UCL	9.512
Kolmogorov-Smirnov 5% Critical Value	0.212	90% BCA Bootstrap UCL	9.918
Data not Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	12.31
		95% Chebyshev(Mean, Sd) UCL	14.56
		97.5% Chebyshev(Mean, Sd) UCL	17.69
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	23.83
90% Approximate Gamma UCL	9.572		
90% Adjusted Gamma UCL	9.789		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Table A-8 - Riverbank Soil Data 90UCL Output
SIUF - OU2
Portland, Oregon

Cd (mg/kg)

General Statistics			
Number of Valid Observations	17	Number of Distinct Observations	14
Raw Statistics		Log-transformed Statistics	
Minimum	0.082	Minimum of Log Data	-2.501
Maximum	1.04	Maximum of Log Data	0.0392
Mean	0.267	Mean of log Data	-1.612
Median	0.19	SD of log Data	0.749
SD	0.245		
Std. Error of Mean	0.0593		
Coefficient of Variation	0.915		
Skewness	2.191		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.729	Shapiro Wilk Test Statistic	0.916
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	0.347	90% H-UCL	0.364
		90% Chebyshev (MVUE) UCL	0.41
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.478
90% Adjusted-CLT UCL (Chen-1995)	0.366	97.5% Chebyshev (MVUE) UCL	0.573
90% Modified-t UCL (Johnson-1978)	0.352	99% Chebyshev (MVUE) UCL	0.759
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.57	Data Follow Appr. Gamma Distribution at 5% Significance Leve	
Theta Star	0.17		
MLE of Mean	0.267		
MLE of Standard Deviation	0.213		
nu star	53.37		
Approximate Chi Square Value (.05)	40.63	Nonparametric Statistics	
Adjusted Level of Significance	0.0823	90% CLT UCL	0.343
Adjusted Chi Square Value	39.71	90% Jackknife UCL	0.347
		90% Standard Bootstrap UCL	0.339
Anderson-Darling Test Statistic	0.792	90% Bootstrap-t UCL	0.397
Anderson-Darling 5% Critical Value	0.751	90% Hall's Bootstrap UCL	0.455
Kolmogorov-Smirnov Test Statistic	0.209	90% Percentile Bootstrap UCL	0.342
Kolmogorov-Smirnov 5% Critical Value	0.212	90% BCA Bootstrap UCL	0.368
Data follow Appr. Gamma Distribution at 5% Significance Leve		90% Chebyshev(Mean, Sd) UCL	0.445
		95% Chebyshev(Mean, Sd) UCL	0.526
		97.5% Chebyshev(Mean, Sd) UCL	0.638
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.858
90% Approximate Gamma UCL	0.351		
90% Adjusted Gamma UCL	0.359		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cu (mg/kg) - 1640

General Statistics			
Number of Valid Observations	17	Number of Distinct Observations	16

Table A-8 - Riverbank Soil Data 90UCL Output
SIUF - OU2
Portland, Oregon

Raw Statistics		Log-transformed Statistics	
Minimum	25.8	Minimum of Log Data	3.25
Maximum	1640	Maximum of Log Data	7.402
Mean	232.6	Mean of log Data	4.782
Median	96.3	SD of log Data	1.056
SD	388.3		
Std. Error of Mean	94.17		
Coefficient of Variation	1.669		
Skewness	3.356		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.526	Shapiro Wilk Test Statistic	0.923
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	358.5	90% H-UCL	353.6
		90% Chebyshev (MVUE) UCL	368.7
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	445.7
90% Adjusted-CLT UCL (Chen-1995)	408	97.5% Chebyshev (MVUE) UCL	552.6
90% Modified-t UCL (Johnson-1978)	371.2	99% Chebyshev (MVUE) UCL	762.5
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.763	Data appear Lognormal at 5% Significance Level	
Theta Star	305		
MLE of Mean	232.6		
MLE of Standard Deviation	266.3		
nu star	25.93		
Approximate Chi Square Value (.05)	17.23	Nonparametric Statistics	
Adjusted Level of Significance	0.0823	90% CLT UCL	353.3
Adjusted Chi Square Value	16.65	90% Jackknife UCL	358.5
		90% Standard Bootstrap UCL	350.1
Anderson-Darling Test Statistic	1.254	90% Bootstrap-t UCL	591.3
Anderson-Darling 5% Critical Value	0.771	90% Hall's Bootstrap UCL	922.9
Kolmogorov-Smirnov Test Statistic	0.267	90% Percentile Bootstrap UCL	357.4
Kolmogorov-Smirnov 5% Critical Value	0.216	90% BCA Bootstrap UCL	424.8
Data not Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	515.1
		95% Chebyshev(Mean, Sd) UCL	643.1
		97.5% Chebyshev(Mean, Sd) UCL	820.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1170
90% Approximate Gamma UCL	349.9		
90% Adjusted Gamma UCL	362.2		

Potential UCL to Use	Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Pb (mg/kg) - 439

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	20

Raw Statistics		Log-transformed Statistics	
Minimum	7.4	Minimum of Log Data	2.001
Maximum	439	Maximum of Log Data	6.084
Mean	67.51	Mean of log Data	3.675
Median	35.5	SD of log Data	0.96
SD	99.44		
Std. Error of Mean	22.23		
Coefficient of Variation	1.473		
Skewness	3.214		

Table A-8 - Riverbank Soil Data 90UCL Output
SIUF - OU2
Portland, Oregon

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.552	Shapiro Wilk Test Statistic	0.957
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	97.03	90% H-UCL	94.76
		90% Chebyshev (MVUE) UCL	104
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	123.6
90% Adjusted-CLT UCL (Chen-1995)	107.4	97.5% Chebyshev (MVUE) UCL	150.9
90% Modified-t UCL (Johnson-1978)	99.69	99% Chebyshev (MVUE) UCL	204.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.94	Data Follow Appr. Gamma Distribution at 5% Significance Leve	
Theta Star	71.84		
MLE of Mean	67.51		
MLE of Standard Deviation	69.64		
nu star	37.59		
Approximate Chi Square Value (.05)	26.99	Nonparametric Statistics	
Adjusted Level of Significance	0.0866	90% CLT UCL	96
Adjusted Chi Square Value	26.44	90% Jackknife UCL	97.03
		90% Standard Bootstrap UCL	94.84
Anderson-Darling Test Statistic	1.142	90% Bootstrap-t UCL	158.8
Anderson-Darling 5% Critical Value	0.767	90% Hall's Bootstrap UCL	267.4
Kolmogorov-Smirnov Test Statistic	0.187	90% Percentile Bootstrap UCL	97.28
Kolmogorov-Smirnov 5% Critical Value	0.199	90% BCA Bootstrap UCL	108.6
Data follow Appr. Gamma Distribution at 5% Significance Leve		90% Chebyshev(Mean, Sd) UCL	134.2
		95% Chebyshev(Mean, Sd) UCL	164.4
		97.5% Chebyshev(Mean, Sd) UCL	206.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	288.7
90% Approximate Gamma UCL	94		
90% Adjusted Gamma UCL	95.98		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zn (mg/kg) - 835

General Statistics			
Number of Valid Observations	17	Number of Distinct Observations	17
Raw Statistics		Log-transformed Statistics	
Minimum	42.3	Minimum of Log Data	3.745
Maximum	835	Maximum of Log Data	6.727
Mean	222.2	Mean of log Data	5.058
Median	118	SD of log Data	0.801
SD	226.6		
Std. Error of Mean	54.96		
Coefficient of Variation	1.02		
Skewness	2.017		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.693	Shapiro Wilk Test Statistic	0.928
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Table A-8 - Riverbank Soil Data 90UCL Output
SIUF - OU2
Portland, Oregon

Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	295.6	90% H-UCL	307.7
		90% Chebyshev (MVUE) UCL	344
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	404
90% Adjusted-CLT UCL (Chen-1995)	311.8	97.5% Chebyshev (MVUE) UCL	487.3
90% Modified-t UCL (Johnson-1978)	300.1	99% Chebyshev (MVUE) UCL	650.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.35	Data appear Lognormal at 5% Significance Level	
Theta Star	164.6		
MLE of Mean	222.2		
MLE of Standard Deviation	191.2		
nu star	45.9		
Approximate Chi Square Value (.05)	34.13	Nonparametric Statistics	
Adjusted Level of Significance	0.0823	90% CLT UCL	292.6
Adjusted Chi Square Value	33.29	90% Jackknife UCL	295.6
		90% Standard Bootstrap UCL	291.1
Anderson-Darling Test Statistic	1.071	90% Bootstrap-t UCL	342.8
Anderson-Darling 5% Critical Value	0.755	90% Hall's Bootstrap UCL	296.6
Kolmogorov-Smirnov Test Statistic	0.232	90% Percentile Bootstrap UCL	291.8
Kolmogorov-Smirnov 5% Critical Value	0.213	90% BCA Bootstrap UCL	308.2
Data not Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	387.1
		95% Chebyshev(Mean, Sd) UCL	461.7
		97.5% Chebyshev(Mean, Sd) UCL	565.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	769
90% Approximate Gamma UCL	298.8		
90% Adjusted Gamma UCL	306.3		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

BaP Equiv (µg/kg) - 1321

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	20
Raw Statistics		Log-transformed Statistics	
Minimum	2.623	Minimum of Log Data	0.964
Maximum	1321	Maximum of Log Data	7.186
Mean	216.3	Mean of log Data	4.637
Median	106.7	SD of log Data	1.367
SD	310.7		
Std. Error of Mean	69.47		
Coefficient of Variation	1.436		
Skewness	2.834		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.628	Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	308.6	90% H-UCL	544.9
		90% Chebyshev (MVUE) UCL	504.5
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	623.2
90% Adjusted-CLT UCL (Chen-1995)	336.8	97.5% Chebyshev (MVUE) UCL	788
90% Modified-t UCL (Johnson-1978)	315.9	99% Chebyshev (MVUE) UCL	1112

Table A-8 - Riverbank Soil Data 90UCL Output
SIUF - OU2
Portland, Oregon

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.715	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	302.5		
MLE of Mean	216.3		
MLE of Standard Deviation	255.8		
nu star	28.6		
Approximate Chi Square Value (.05)	19.44	Nonparametric Statistics	
Adjusted Level of Significance	0.0866	90% CLT UCL	305.4
Adjusted Chi Square Value	18.97	90% Jackknife UCL	308.6
		90% Standard Bootstrap UCL	305.2
Anderson-Darling Test Statistic	0.476	90% Bootstrap-t UCL	401.6
Anderson-Darling 5% Critical Value	0.777	90% Hall's Bootstrap UCL	731
Kolmogorov-Smirnov Test Statistic	0.146	90% Percentile Bootstrap UCL	308.5
Kolmogorov-Smirnov 5% Critical Value	0.201	90% BCA Bootstrap UCL	354.8
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	424.7
		95% Chebyshev(Mean, Sd) UCL	519.1
		97.5% Chebyshev(Mean, Sd) UCL	650.2
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	907.6
90% Approximate Gamma UCL	318.3		
90% Adjusted Gamma UCL	326.1		

Potential UCL to Use — Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PCB µg/kg - 613

General Statistics			
Number of Valid Data	19	Number of Detected Data	15
Number of Distinct Detected Data	15	Number of Non-Detect Data	4
		Percent Non-Detects	21.05%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	613	Maximum Detected	6.418
Mean of Detected	93.05	Mean of Detected	3.782
SD of Detected	151.6	SD of Detected	1.227
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	110	Maximum Non-Detect	4.7
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	84.21%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.551	Shapiro Wilk Test Statistic	0.945
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	76.81	Mean	3.363
SD	138	SD	1.494
90% DL/2 (t) UCL	118.9	90% H-Stat (DL/2) UCL	208.9
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	397.7	Mean in Log Scale	3.313
SD	215.9	SD in Log Scale	1.485
90% MLE (t) UCL	463.6	Mean in Original Scale	74.98
90% MLE (Tiku) UCL	557.1	SD in Original Scale	138.5
		90% t UCL	117.3
		90% Percentile Bootstrap UCL	115.3

Table A-8 - Riverbank Soil Data 90UCL Output
SIUF - OU2
Portland, Oregon

		90% BCA Bootstrap UCL	145.6
		90% H UCL	194.2
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.677	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	137.4		
nu star	20.32		
A-D Test Statistic	0.684	Nonparametric Statistics	
5% A-D Critical Value	0.773	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.773	Mean	76.44
5% K-S Critical Value	0.23	SD	134.3
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	31.93
		90% KM (t) UCL	118.9
Assuming Gamma Distribution		90% KM (z) UCL	117.4
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	118.3
Minimum	1.00E-06	90% KM (bootstrap t) UCL	191.5
Maximum	613	90% KM (BCA) UCL	114
Mean	74.15	90% KM (Percentile Bootstrap) UCL	118.1
Median	25.7	90% KM (Chebyshev) UCL	172.2
SD	138.9	95% KM (Chebyshev) UCL	215.6
k star	0.217	97.5% KM (Chebyshev) UCL	275.9
Theta star	341.8	99% KM (Chebyshev) UCL	394.2
Nu star	8.245		
AppChi2	3.655	Potential UCL to Use	
90% Gamma Approximate UCL	167.3	Recommendation Provided only	
90% Adjusted Gamma UCL	177.2	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

Table A-9 - Copper Action Level 90UCL Input Data
SIUF - OU2
Portland, Oregon

Cu (mg/kg)	Cu (mg/kg)	Cu (mg/kg)	Cu (mg/kg) - 284
1,640	567	298	284
567	298	284	271
298	284	271	125
284	271	125	112
271	125	112	112
125	112	112	96.3
112	112	96.3	92.4
112	96.3	92.4	62.5
96.3	92.4	62.5	61.4
92.4	62.5	61.4	60.1
62.5	61.4	60.1	57.2
61.4	60.1	57.2	46.7
60.1	57.2	46.7	42.4
57.2	46.7	42.4	25.8
46.7	42.4	25.8	
42.4	25.8		
25.8			

Table A-10 - Lead Action Level 90UCL Input Data
SIUF - OU2
Portland, Oregon

Pb (mg/kg)	Pb (mg/kg) - 225
439	225
225	85.6
85.6	78.2
78.2	77.6
77.6	58.2
58.2	51.3
51.3	43.2
43.2	42.6
42.6	36
36	35.0
35.0	30.1
30.1	27.2
27.2	24.6
24.6	23.2
23.2	21.4
21.4	17.1
17.1	15.4
15.4	12.0
12.0	7.4
7.4	

Table A-11 - PCBs Action Level 90UCL Input Data
SIUF - OU2
Portland, Oregon

PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg	PCB µg/kg	d_PCB µg/kg - 58
613	1	156	1	154	1	110	0	77.3	1	77	1	72	1	71.1	1	58	1
156	1	154	1	110	0	77.3	1	77	1	72	1	71.1	1	58	1	26.4	1
154	1	110	0	77.3	1	77	1	72	1	71.1	1	58	1	26.4	1	25.7	1
110	0	77.3	1	77	1	72	1	71.1	1	58	1	26.4	1	25.7	1	24.8	1
77.3	1	77	1	72	1	71.1	1	58	1	26.4	1	25.7	1	24.8	1	12.6	1
77	1	72	1	71.1	1	58	1	26.4	1	25.7	1	24.8	1	12.6	1	10.3	1
72	1	71.1	1	58	1	26.4	1	25.7	1	24.8	1	12.6	1	10.3	1	9.8	1
71.1	1	58	1	26.4	1	25.7	1	24.8	1	12.6	1	10.3	1	9.8	1	7.8	1
58	1	26.4	1	25.7	1	24.8	1	12.6	1	10.3	1	9.8	1	7.8	1	6.2	0
26.4	1	25.7	1	24.8	1	12.6	1	10.3	1	9.8	1	7.8	1	6.2	0	5.5	0
25.7	1	24.8	1	12.6	1	10.3	1	9.8	1	7.8	1	6.2	0	5.5	0	5.5	0
24.8	1	12.6	1	10.3	1	9.8	1	7.8	1	6.2	0	5.5	0	5.5	0		
12.6	1	10.3	1	9.8	1	7.8	1	6.2	0	5.5	0	5.5	0				
10.3	1	9.8	1	7.8	1	6.2	0	5.5	0	5.5	0						
9.8	1	7.8	1	6.2	0	5.5	0	5.5	0								
7.8	1	6.2	0	5.5	0	5.5	0										
6.2	0	5.5	0	5.5	0												
5.5	0	5.5	0														
5.5	0																

Table A-12 - Riverbank Soil Copper Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

General UCL Statistics for Full Data Sets

User Selected Options	
From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Cu (mg/kg) - 1640

General Statistics			
Number of Valid Observations	17	Number of Distinct Observations	16
Raw Statistics		Log-transformed Statistics	
Minimum	25.8	Minimum of Log Data	3.25
Maximum	1640	Maximum of Log Data	7.402
Mean	232.6	Mean of log Data	4.782
Median	96.3	SD of log Data	1.056
SD	388.3		
Std. Error of Mean	94.17		
Coefficient of Variation	1.669		
Skewness	3.356		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.526	Shapiro Wilk Test Statistic	0.923
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	358.5	90% H-UCL	353.6
		90% Chebyshev (MVUE) UCL	368.7
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	445.7
90% Adjusted-CLT UCL (Chen-1995)	408	97.5% Chebyshev (MVUE) UCL	552.6
90% Modified-t UCL (Johnson-1978)	371.2	99% Chebyshev (MVUE) UCL	762.5
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.763	Data appear Lognormal at 5% Significance Level	
Theta Star	305		
MLE of Mean	232.6		
MLE of Standard Deviation	266.3		
nu star	25.93		
Approximate Chi Square Value (.05)	17.23	Nonparametric Statistics	
Adjusted Level of Significance	0.0823	90% CLT UCL	353.3
Adjusted Chi Square Value	16.65	90% Jackknife UCL	358.5
		90% Standard Bootstrap UCL	350.3
Anderson-Darling Test Statistic	1.254	90% Bootstrap-t UCL	638.1
Anderson-Darling 5% Critical Value	0.771	90% Hall's Bootstrap UCL	920
Kolmogorov-Smirnov Test Statistic	0.267	90% Percentile Bootstrap UCL	361
Kolmogorov-Smirnov 5% Critical Value	0.216	90% BCA Bootstrap UCL	428.1
Data not Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	515.1
		95% Chebyshev(Mean, Sd) UCL	643.1
		97.5% Chebyshev(Mean, Sd) UCL	820.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1170
90% Approximate Gamma UCL	349.9		
90% Adjusted Gamma UCL	362.2		

Table A-12 - Riverbank Soil Copper Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

Potential UCL to Use — Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cu (mg/kg) - 567

General Statistics

Number of Valid Observations	16	Number of Distinct Observations	15
Raw Statistics		**Log-transformed Statistics**	
Minimum	25.8	Minimum of Log Data	3.25
Maximum	567	Maximum of Log Data	6.34
Mean	144.6	Mean of log Data	4.618
Median	94.35	SD of log Data	0.839
SD	143.2		
Std. Error of Mean	35.8		
Coefficient of Variation	0.99		
Skewness	2.006		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.738	Shapiro Wilk Test Statistic	0.948
Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
90% Student's-t UCL	192.6	90% H-UCL	212.6
		90% Chebyshev (MVUE) UCL	234.7
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	277.6
90% Adjusted-CLT UCL (Chen-1995)	203.3	97.5% Chebyshev (MVUE) UCL	337.2
90% Modified-t UCL (Johnson-1978)	195.6	99% Chebyshev (MVUE) UCL	454.2
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.3	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	111.2		
MLE of Mean	144.6		
MLE of Standard Deviation	126.8		
nu star	41.6		
Approximate Chi Square Value (.05)	30.43	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0809	90% CLT UCL	190.5
Adjusted Chi Square Value	29.57	90% Jackknife UCL	192.6
		90% Standard Bootstrap UCL	188.7
Anderson-Darling Test Statistic	0.762	90% Bootstrap-t UCL	223.9
Anderson-Darling 5% Critical Value	0.754	90% Hall's Bootstrap UCL	220.6
Kolmogorov-Smirnov Test Statistic	0.212	90% Percentile Bootstrap UCL	192.6
Kolmogorov-Smirnov 5% Critical Value	0.219	90% BCA Bootstrap UCL	201.2
Data follow Appr. Gamma Distribution at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	252
		95% Chebyshev(Mean, Sd) UCL	300.6
		97.5% Chebyshev(Mean, Sd) UCL	368.2
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	500.8
90% Approximate Gamma UCL	197.7		
90% Adjusted Gamma UCL	203.5		

Potential UCL to Use — Recommendation Provided only for 95% Confidence Coefficient

Table A-12 - Riverbank Soil Copper Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cu (mg/kg) - 298

General Statistics			
Number of Valid Observations	15	Number of Distinct Observations	14
Raw Statistics		Log-transformed Statistics	
Minimum	25.8	Minimum of Log Data	3.25
Maximum	298	Maximum of Log Data	5.697
Mean	116.5	Mean of log Data	4.503
Median	92.4	SD of log Data	0.726
SD	91.5		
Std. Error of Mean	23.62		
Coefficient of Variation	0.786		
Skewness	1.308		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.777	Shapiro Wilk Test Statistic	0.937
Shapiro Wilk Critical Value	0.881	Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	148.2	90% H-UCL	163.9
		90% Chebyshev (MVUE) UCL	183.5
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	214.5
90% Adjusted-CLT UCL (Chen-1995)	152.4	97.5% Chebyshev (MVUE) UCL	257.5
90% Modified-t UCL (Johnson-1978)	149.6	99% Chebyshev (MVUE) UCL	342
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.737	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	67.05		
MLE of Mean	116.5		
MLE of Standard Deviation	88.36		
nu star	52.11		
Approximate Chi Square Value (.05)	39.53	Nonparametric Statistics	
Adjusted Level of Significance	0.0795	90% CLT UCL	146.7
Adjusted Chi Square Value	38.46	90% Jackknife UCL	148.2
		90% Standard Bootstrap UCL	145.4
Anderson-Darling Test Statistic	0.706	90% Bootstrap-t UCL	159
Anderson-Darling 5% Critical Value	0.747	90% Hall's Bootstrap UCL	147.7
Kolmogorov-Smirnov Test Statistic	0.186	90% Percentile Bootstrap UCL	146.1
Kolmogorov-Smirnov 5% Critical Value	0.224	90% BCA Bootstrap UCL	151.6
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	187.3
		95% Chebyshev(Mean, Sd) UCL	219.4
		97.5% Chebyshev(Mean, Sd) UCL	264
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	351.5
90% Approximate Gamma UCL	153.5		
90% Adjusted Gamma UCL	157.8		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

Table A-12 - Riverbank Soil Copper Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cu (mg/kg) - 284

General Statistics			
Number of Valid Observations	14	Number of Distinct Observations	13
Raw Statistics		Log-transformed Statistics	
Minimum	25.8	Minimum of Log Data	3.25
Maximum	284	Maximum of Log Data	5.649
Mean	103.5	Mean of log Data	4.418
Median	77.45	SD of log Data	0.671
SD	79.37		
Std. Error of Mean	21.21		
Coefficient of Variation	0.767		
Skewness	1.685		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.765	Shapiro Wilk Test Statistic	0.949
Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	132.1	90% H-UCL	141.9
		90% Chebyshev (MVUE) UCL	159.3
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	185.3
90% Adjusted-CLT UCL (Chen-1995)	137.5	97.5% Chebyshev (MVUE) UCL	221.4
90% Modified-t UCL (Johnson-1978)	133.7	99% Chebyshev (MVUE) UCL	292.3
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.939	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	53.36		
MLE of Mean	103.5		
MLE of Standard Deviation	74.31		
nu star	54.3		
Approximate Chi Square Value (.05)	41.44	Nonparametric Statistics	
Adjusted Level of Significance	0.0781	90% CLT UCL	130.7
Adjusted Chi Square Value	40.27	90% Jackknife UCL	132.1
		90% Standard Bootstrap UCL	128.6
Anderson-Darling Test Statistic	0.595	90% Bootstrap-t UCL	156.8
Anderson-Darling 5% Critical Value	0.745	90% Hall's Bootstrap UCL	307.3
Kolmogorov-Smirnov Test Statistic	0.191	90% Percentile Bootstrap UCL	130.6
Kolmogorov-Smirnov 5% Critical Value	0.231	90% BCA Bootstrap UCL	135.2
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	167.1
		95% Chebyshev(Mean, Sd) UCL	195.9
		97.5% Chebyshev(Mean, Sd) UCL	236
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	314.5
90% Approximate Gamma UCL	135.6		
90% Adjusted Gamma UCL	139.5		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Table A-13 - Riverbank Soil Lead Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

General UCL Statistics for Full Data Sets

User Selected Options	
From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Pb (mg/kg) - 439

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	20
Raw Statistics		Log-transformed Statistics	
Minimum	7.4	Minimum of Log Data	2.001
Maximum	439	Maximum of Log Data	6.084
Mean	67.51	Mean of log Data	3.675
Median	35.5	SD of log Data	0.96
SD	99.44		
Std. Error of Mean	22.23		
Coefficient of Variation	1.473		
Skewness	3.214		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.552	Shapiro Wilk Test Statistic	0.957
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	97.03	90% H-UCL	94.76
		90% Chebyshev (MVUE) UCL	104
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	123.6
90% Adjusted-CLT UCL (Chen-1995)	107.4	97.5% Chebyshev (MVUE) UCL	150.9
90% Modified-t UCL (Johnson-1978)	99.69	99% Chebyshev (MVUE) UCL	204.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.94	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	71.84		
MLE of Mean	67.51		
MLE of Standard Deviation	69.64		
nu star	37.59		
Approximate Chi Square Value (.05)	26.99	Nonparametric Statistics	
Adjusted Level of Significance	0.0866	90% CLT UCL	96
Adjusted Chi Square Value	26.44	90% Jackknife UCL	97.03
		90% Standard Bootstrap UCL	94.57
Anderson-Darling Test Statistic	1.142	90% Bootstrap-t UCL	157
Anderson-Darling 5% Critical Value	0.767	90% Hall's Bootstrap UCL	266
Kolmogorov-Smirnov Test Statistic	0.187	90% Percentile Bootstrap UCL	95.53
Kolmogorov-Smirnov 5% Critical Value	0.199	90% BCA Bootstrap UCL	111.1
Data follow Appr. Gamma Distribution at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	134.2
		95% Chebyshev(Mean, Sd) UCL	164.4
		97.5% Chebyshev(Mean, Sd) UCL	206.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	288.7
90% Approximate Gamma UCL	94		
90% Adjusted Gamma UCL	95.98		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Table A-13 - Riverbank Soil Lead Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Pb (mg/kg) - 225

General Statistics			
Number of Valid Observations	19	Number of Distinct Observations	19
Raw Statistics		Log-transformed Statistics	
Minimum	7.4	Minimum of Log Data	2.001
Maximum	225	Maximum of Log Data	5.416
Mean	47.95	Mean of log Data	3.548
Median	35	SD of log Data	0.796
SD	48.65		
Std. Error of Mean	11.16		
Coefficient of Variation	1.014		
Skewness	2.921		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.674	Shapiro Wilk Test Statistic	0.987
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	62.8	90% H-UCL	65.9
		90% Chebyshev (MVUE) UCL	74.33
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	86.85
90% Adjusted-CLT UCL (Chen-1995)	67.6	97.5% Chebyshev (MVUE) UCL	104.2
90% Modified-t UCL (Johnson-1978)	64.05	99% Chebyshev (MVUE) UCL	138.3
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.466	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	32.7		
MLE of Mean	47.95		
MLE of Standard Deviation	39.6		
nu star	55.72		
Approximate Chi Square Value (.05)	42.69	Nonparametric Statistics	
Adjusted Level of Significance	0.0852	90% CLT UCL	62.26
Adjusted Chi Square Value	41.9	90% Jackknife UCL	62.8
		90% Standard Bootstrap UCL	61.46
Anderson-Darling Test Statistic	0.426	90% Bootstrap-t UCL	78.08
Anderson-Darling 5% Critical Value	0.755	90% Hall's Bootstrap UCL	136.7
Kolmogorov-Smirnov Test Statistic	0.134	90% Percentile Bootstrap UCL	62.51
Kolmogorov-Smirnov 5% Critical Value	0.202	90% BCA Bootstrap UCL	69.93
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	81.43
		95% Chebyshev(Mean, Sd) UCL	96.6
		97.5% Chebyshev(Mean, Sd) UCL	117.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	159
90% Approximate Gamma UCL	62.59		
90% Adjusted Gamma UCL	63.76		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Table A-13 - Riverbank Soil Lead Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

PCB µg/kg - 613

General Statistics			
Number of Valid Data	19	Number of Detected Data	15
Number of Distinct Detected Data	15	Number of Non-Detect Data	4
		Percent Non-Detects	21.05%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	613	Maximum Detected	6.418
Mean of Detected	93.05	Mean of Detected	3.782
SD of Detected	151.6	SD of Detected	1.227
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	110	Maximum Non-Detect	4.7
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	84.21%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.551	Shapiro Wilk Test Statistic	0.945
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	76.81	Mean	3.363
SD	138	SD	1.494
90% DL/2 (t) UCL	118.9	90% H-Stat (DL/2) UCL	208.9
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	397.7	Mean in Log Scale	3.313
SD	215.9	SD in Log Scale	1.485
90% MLE (t) UCL	463.6	Mean in Original Scale	74.98
90% MLE (Tiku) UCL	557.1	SD in Original Scale	138.5
		90% t UCL	117.3
		90% Percentile Bootstrap UCL	118.6
		90% BCA Bootstrap UCL	143.2
		90% H UCL	194.2
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.677	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	137.4		
nu star	20.32		
A-D Test Statistic	0.684	Nonparametric Statistics	
5% A-D Critical Value	0.773	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.773	Mean	76.44

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

5% K-S Critical Value	0.23	SD	134.3
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	31.93
		90% KM (t) UCL	118.9
Assuming Gamma Distribution		90% KM (z) UCL	117.4
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	118.3
Minimum	1.00E-06	90% KM (bootstrap t) UCL	193.4
Maximum	613	90% KM (BCA) UCL	113
Mean	74.15	90% KM (Percentile Bootstrap) UCL	117
Median	25.7	90% KM (Chebyshev) UCL	172.2
SD	138.9	95% KM (Chebyshev) UCL	215.6
k star	0.217	97.5% KM (Chebyshev) UCL	275.9
Theta star	341.8	99% KM (Chebyshev) UCL	394.2
Nu star	8.245		
AppChi2	3.655	Potential UCL to Use	
90% Gamma Approximate UCL	167.3	Recommendation Provided only	
90% Adjusted Gamma UCL	177.2	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

PCB µg/kg - 156

General Statistics

Number of Valid Data	18	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	4
		Percent Non-Detects	22.22%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	156	Maximum Detected	5.05
Mean of Detected	55.91	Mean of Detected	3.594
SD of Detected	49.76	SD of Detected	1.024
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	110	Maximum Non-Detect	4.7

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	88.89%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.832	Shapiro Wilk Test Statistic	0.915
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	47.02	Mean	3.193
SD	48.02	SD	1.336
90% DL/2 (t) UCL	62.11	90% H-Stat (DL/2) UCL	124.8

Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.193
		SD in Log Scale	1.233
		Mean in Original Scale	45.28
		SD in Original Scale	48.2
		90% t UCL	60.43
		90% Percentile Bootstrap UCL	60.19

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

		90% BCA Bootstrap UCL	62.01
		90% H-UCL	99.89
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.072	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	52.15		
nu star	30.02		
A-D Test Statistic	0.503	Nonparametric Statistics	
5% A-D Critical Value	0.754	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.754	Mean	46.63
5% K-S Critical Value	0.234	SD	46.47
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	11.49
		90% KM (t) UCL	61.94
Assuming Gamma Distribution		90% KM (z) UCL	61.35
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	61.59
Minimum	1.00E-06	90% KM (bootstrap t) UCL	65.47
Maximum	156	90% KM (BCA) UCL	60.99
Mean	44.99	90% KM (Percentile Bootstrap) UCL	61.67
Median	26.05	90% KM (Chebyshev) UCL	81.09
SD	48.66	95% KM (Chebyshev) UCL	96.7
k star	0.229	97.5% KM (Chebyshev) UCL	118.4
Theta star	196.8	99% KM (Chebyshev) UCL	160.9
Nu star	8.232		
AppChi2	3.646	Potential UCL to Use	
90% Gamma Approximate UCL	101.6	Recommendation Provided only	
90% Adjusted Gamma UCL	108.2	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

PCB µg/kg - 154

General Statistics			
Number of Valid Data	17	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	4
		Percent Non-Detects	23.53%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	154	Maximum Detected	5.037
Mean of Detected	48.22	Mean of Detected	3.482
SD of Detected	42.23	SD of Detected	0.973
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	110	Maximum Non-Detect	4.7
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.12%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.837	Shapiro Wilk Test Statistic	0.917
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

Mean	40.61	Mean	3.084
SD	40.8	SD	1.291
90% DL/2 (t) UCL	53.84	90% H-Stat (DL/2) UCL	104.4
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.084
		SD in Log Scale	1.176
		Mean in Original Scale	38.75
		SD in Original Scale	40.72
		90% t UCL	51.96
		90% Percentile Bootstrap UCL	52.08
		90% BCA Bootstrap UCL	53.85
		90% H-UCL	81.61
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.138	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	42.37		
nu star	29.59		
A-D Test Statistic	0.524	Nonparametric Statistics	
5% A-D Critical Value	0.752	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.752	Mean	40.19
5% K-S Critical Value	0.241	SD	39.26
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	10.07
		90% KM (t) UCL	53.65
Assuming Gamma Distribution		90% KM (z) UCL	53.1
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	53.29
Minimum	1.00E-06	90% KM (bootstrap t) UCL	56.71
Maximum	154	90% KM (BCA) UCL	52.95
Mean	38.5	90% KM (Percentile Bootstrap) UCL	52.78
Median	25.7	90% KM (Chebyshev) UCL	70.4
SD	41.22	95% KM (Chebyshev) UCL	84.08
k star	0.224	97.5% KM (Chebyshev) UCL	103.1
Theta star	172.2	99% KM (Chebyshev) UCL	140.4
Nu star	7.599		
AppChi2	3.225	Potential UCL to Use	
90% Gamma Approximate UCL	90.72	Recommendation Provided only	
90% Adjusted Gamma UCL	97.61	for 95% Confidence Coeficient	
Note: DL/2 is not a recommended method.			

PCB µg/kg - 110

General Statistics			
Number of Valid Data	16	Number of Detected Data	12
Number of Distinct Detected Data	12	Number of Non-Detect Data	4
		Percent Non-Detects	25.00%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	77.3	Maximum Detected	4.348
Mean of Detected	39.4	Mean of Detected	3.352
SD of Detected	29.04	SD of Detected	0.891
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	110	Maximum Non-Detect	4.7
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.821	Shapiro Wilk Test Statistic	0.866
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	33.53	Mean	2.962
SD	29.4	SD	1.228
90% DL/2 (t) UCL	43.38	90% H-Stat (DL/2) UCL	82.95
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	2.947
		SD in Log Scale	1.117
		Mean in Original Scale	31.47
		SD in Original Scale	28.83
		90% t UCL	41.13
		90% Percentile Bootstrap UCL	40.68
		90% BCA Bootstrap UCL	41.24
		90% H-UCL	64.96
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.332	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	29.57		
nu star	31.97		
A-D Test Statistic	0.736	Nonparametric Statistics	
5% A-D Critical Value	0.744	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.744	Mean	33.08
5% K-S Critical Value	0.249	SD	27.89
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	7.522
		90% KM (t) UCL	43.16
Assuming Gamma Distribution		90% KM (z) UCL	42.72
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	42.84
Minimum	1.00E-06	90% KM (bootstrap t) UCL	44.13
Maximum	77.3	90% KM (BCA) UCL	43.33
Mean	31.29	90% KM (Percentile Bootstrap) UCL	42.78
Median	25.25	90% KM (Chebyshev) UCL	55.65
SD	29.45	95% KM (Chebyshev) UCL	65.87
k star	0.22	97.5% KM (Chebyshev) UCL	80.06
Theta star	142.5	99% KM (Chebyshev) UCL	107.9
Nu star	7.029		
AppChi2	2.853	Potential UCL to Use	
90% Gamma Approximate UCL	77.09	Recommendation Provided only	
90% Adjusted Gamma UCL	83.84	for 95% Confidence Coeficient	
Note: DL/2 is not a recommended method.			

PCB µg/kg - 77.3

General Statistics			
Number of Valid Data	15	Number of Detected Data	12
Number of Distinct Detected Data	12	Number of Non-Detect Data	3

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

		Percent Non-Detects	20.00%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	77.3	Maximum Detected	4.348
Mean of Detected	39.4	Mean of Detected	3.352
SD of Detected	29.04	SD of Detected	0.891
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	6.2	Maximum Non-Detect	1.825
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	12
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	20.00%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.821	Shapiro Wilk Test Statistic	0.866
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	32.09	Mean	2.892
SD	29.85	SD	1.238
90% DL/2 (t) UCL	42.46	90% H-Stat (DL/2) UCL	81.83
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	28.75	Mean in Log Scale	2.947
SD	33.56	SD in Log Scale	1.156
90% MLE (t) UCL	40.41	Mean in Original Scale	32.29
90% MLE (Tiku) UCL	40.56	SD in Original Scale	29.65
		90% t UCL	42.59
		90% Percentile Bootstrap UCL	41.35
		90% BCA Bootstrap UCL	42.67
		90% H UCL	72.43
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.332	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	29.57		
nu star	31.97		
A-D Test Statistic	0.736	Nonparametric Statistics	
5% A-D Critical Value	0.744	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.744	Mean	33.08
5% K-S Critical Value	0.249	SD	27.89
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	7.522
		90% KM (t) UCL	43.2
Assuming Gamma Distribution		90% KM (z) UCL	42.72
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	42.85
Minimum	1.00E-06	90% KM (bootstrap t) UCL	43.6
Maximum	77.3	90% KM (BCA) UCL	43.08
Mean	31.52	90% KM (Percentile Bootstrap) UCL	43.14
Median	24.8	90% KM (Chebyshev) UCL	55.65
SD	30.47	95% KM (Chebyshev) UCL	65.87
k star	0.21	97.5% KM (Chebyshev) UCL	80.06
Theta star	149.9	99% KM (Chebyshev) UCL	107.9
Nu star	6.306		

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

AppChi2	2.395	Potential UCL to Use	
90% Gamma Approximate UCL	82.99	Recommendation Provided only	
90% Adjusted Gamma UCL	91.51	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

PCB µg/kg - 77

General Statistics			
Number of Valid Data	14	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	3
		Percent Non-Detects	21.43%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	77	Maximum Detected	4.344
Mean of Detected	35.95	Mean of Detected	3.262
SD of Detected	27.76	SD of Detected	0.875
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	6.2	Maximum Non-Detect	1.825
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	11
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	21.43%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.825	Shapiro Wilk Test Statistic	0.885
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	28.86	Mean	2.788
SD	28.13	SD	1.215
90% DL/2 (t) UCL	39.02	90% H-Stat (DL/2) UCL	72.8
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	25.38	Mean in Log Scale	2.825
SD	31.86	SD in Log Scale	1.163
90% MLE (t) UCL	36.88	Mean in Original Scale	28.99
90% MLE (Tiku) UCL	37.05	SD in Original Scale	28
		90% t UCL	39.1
		90% Percentile Bootstrap UCL	39.04
		90% BCA Bootstrap UCL	39.86
		90% H UCL	67.39
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.302	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	27.61		
nu star	28.65		
A-D Test Statistic	0.624	Nonparametric Statistics	
5% A-D Critical Value	0.741	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.741	Mean	29.92
5% K-S Critical Value	0.259	SD	26.15
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	7.331

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

		90% KM (t) UCL	39.82
Assuming Gamma Distribution		90% KM (z) UCL	39.32
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	39.44
Minimum	1.00E-06	90% KM (bootstrap t) UCL	41.45
Maximum	77	90% KM (BCA) UCL	40.49
Mean	28.25	90% KM (Percentile Bootstrap) UCL	39.17
Median	18.7	90% KM (Chebyshev) UCL	51.91
SD	28.76	95% KM (Chebyshev) UCL	61.87
k star	0.203	97.5% KM (Chebyshev) UCL	75.7
Theta star	139.4	99% KM (Chebyshev) UCL	102.9
Nu star	5.673		
AppChi2	2.008	Potential UCL to Use	
90% Gamma Approximate UCL	79.82	Recommendation Provided only	
90% Adjusted Gamma UCL	89.38	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

PCB µg/kg - 72

General Statistics			
Number of Valid Data	13	Number of Detected Data	10
Number of Distinct Detected Data	10	Number of Non-Detect Data	3
		Percent Non-Detects	23.08%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	72	Maximum Detected	4.277
Mean of Detected	31.85	Mean of Detected	3.153
SD of Detected	25.5	SD of Detected	0.841
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	6.2	Maximum Non-Detect	1.825
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	10
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	23.08%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.812	Shapiro Wilk Test Statistic	0.896
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	25.16	Mean	2.668
SD	25.48	SD	1.175
90% DL/2 (t) UCL	34.75	90% H-Stat (DL/2) UCL	61.67
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	21.69	Mean in Log Scale	2.691
SD	29.09	SD in Log Scale	1.146
90% MLE (t) UCL	32.63	Mean in Original Scale	25.24
90% MLE (Tiku) UCL	32.83	SD in Original Scale	25.41
		90% t UCL	34.8
		90% Percentile Bootstrap UCL	33.95
		90% BCA Bootstrap UCL	35.88
		90% H UCL	59.16

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.308	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	24.34		
nu star	26.17		
A-D Test Statistic	0.557	Nonparametric Statistics	
5% A-D Critical Value	0.737	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.737	Mean	26.3
5% K-S Critical Value	0.27	SD	23.51
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	6.874
		90% KM (t) UCL	35.62
Assuming Gamma Distribution		90% KM (z) UCL	35.11
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	35.21
Minimum	1.00E-06	90% KM (bootstrap t) UCL	38.01
Maximum	72	90% KM (BCA) UCL	36.47
Mean	24.5	90% KM (Percentile Bootstrap) UCL	35.19
Median	12.6	90% KM (Chebyshev) UCL	46.92
SD	26.13	95% KM (Chebyshev) UCL	56.27
k star	0.196	97.5% KM (Chebyshev) UCL	69.23
Theta star	125.2	99% KM (Chebyshev) UCL	94.7
Nu star	5.086		
AppChi2	1.662	Potential UCL to Use	
90% Gamma Approximate UCL	74.95	Recommendation Provided only	
90% Adjusted Gamma UCL	85.43	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

PCB µg/kg - 71.1

General Statistics			
Number of Valid Data	12	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	3
		Percent Non-Detects	25.00%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	71.1	Maximum Detected	4.264
Mean of Detected	27.39	Mean of Detected	3.029
SD of Detected	22.53	SD of Detected	0.788
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	6.2	Maximum Non-Detect	1.825
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	25.00%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.809	Shapiro Wilk Test Statistic	0.914

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	21.26	Mean	2.534
SD	22.19	SD	1.119
90% DL/2 (t) UCL	29.99	90% H-Stat (DL/2) UCL	49.87
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	17.93	Mean in Log Scale	2.548
SD	25.53	SD in Log Scale	1.104
90% MLE (t) UCL	27.98	Mean in Original Scale	21.31
90% MLE (Tiku) UCL	28.22	SD in Original Scale	22.14
		90% t UCL	30.03
		90% Percentile Bootstrap UCL	29.22
		90% BCA Bootstrap UCL	30.41
		90% H UCL	48.94
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.358	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	20.17		
nu star	24.45		
A-D Test Statistic	0.492	Nonparametric Statistics	
5% A-D Critical Value	0.73	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.73	Mean	22.49
5% K-S Critical Value	0.283	SD	20.26
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	6.203
		90% KM (t) UCL	30.95
Assuming Gamma Distribution		90% KM (z) UCL	30.44
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	30.5
Minimum	1.00E-06	90% KM (bootstrap t) UCL	35.92
Maximum	71.1	90% KM (BCA) UCL	31.47
Mean	20.54	90% KM (Percentile Bootstrap) UCL	30.63
Median	11.45	90% KM (Chebyshev) UCL	41.1
SD	22.86	95% KM (Chebyshev) UCL	49.53
k star	0.189	97.5% KM (Chebyshev) UCL	61.23
Theta star	108.6	99% KM (Chebyshev) UCL	84.21
Nu star	4.54		
AppChi2	1.356	Potential UCL to Use	
90% Gamma Approximate UCL	68.79	Recommendation Provided only	
90% Adjusted Gamma UCL	80.03	for 95% Confidence Coeficient	
Note: DL/2 is not a recommended method.			

PCB µg/kg - 58

General Statistics			
Number of Valid Data	11	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	3
		Percent Non-Detects	27.27%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	58	Maximum Detected	4.06
Mean of Detected	21.93	Mean of Detected	2.874

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

SD of Detected	16.53	SD of Detected	0.681
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	6.2	Maximum Non-Detect	1.825
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	8
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	27.27%

Warning: There are only 8 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.795	Shapiro Wilk Test Statistic	0.915
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	16.73	Mean	2.377
SD	16.45	SD	1.025
90% DL/2 (t) UCL	23.53	90% H-Stat (DL/2) UCL	36.54
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	14.21	Mean in Log Scale	2.416
SD	18.99	SD in Log Scale	0.976
90% MLE (t) UCL	22.06	Mean in Original Scale	16.86
90% MLE (Tiku) UCL	22.35	SD in Original Scale	16.33
		90% t UCL	23.62
		90% Percentile Bootstrap UCL	23.23
		90% BCA Bootstrap UCL	24.97
		90% H UCL	34.31
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.644	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	13.34		
nu star	26.3		
A-D Test Statistic	0.474	Nonparametric Statistics	
5% A-D Critical Value	0.723	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.723	Mean	18.07
5% K-S Critical Value	0.297	SD	14.61
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	4.709
		90% KM (t) UCL	24.53
Assuming Gamma Distribution		90% KM (z) UCL	24.11
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	24.07
Minimum	1.00E-06	90% KM (bootstrap t) UCL	29.31
Maximum	58	90% KM (BCA) UCL	25.26
Mean	15.95	90% KM (Percentile Bootstrap) UCL	24.35
Median	10.3	90% KM (Chebyshev) UCL	32.2
SD	17.21	95% KM (Chebyshev) UCL	38.6
k star	0.184	97.5% KM (Chebyshev) UCL	47.48
Theta star	86.64	99% KM (Chebyshev) UCL	64.93

Table A-14 - Riverbank Soil PCB Action Level 90UCL Output
SIUF - OU2
Portland, Oregon

Nu star	4.049	
AppChi2	1.094	Potential UCL to Use
90% Gamma Approximate UCL	59.03	Recommendation Provided only
90% Adjusted Gamma UCL	70.28	for 95% Confidence Coeficient

Note: DL/2 is not a recommended method.

Table A-15 - Copper Cost/Benefit

Max. Conc. mg/kg	Sample No.	90UCL (mg/kg) without Source Control	Erosion Feature	"Cost" (Length in feet)	"Benefit" (Marginal Reduction in 90UCL with Source Control)	Cost-Benefit Slope
1640	RB-10b	515	L	56	87%	0.02
567	RB-13b	198	J	635	12%	0.0002
298	RB-9a	154	M	53	1%	0.0003
Source Control Goal		149				

Table A-16 - Lead Cost/Benefit

Max. Conc. mg/kg	Sample No.	90UCL (mg/kg)	Erosion Feature	"Cost" (Length in feet)	"Benefit" (Marginal Reduction in 90UCL with Source Control)
439	RB-10b	94	L	56	100%
Source Control Goal		410			

Table A-17 - PCBs Cost/Benefit

Max. Conc. mg/kg	Sample No.	90UCL (mg/kg) without Source Control	Erosion Feature	"Cost" (Length in feet)	"Benefit" (Marginal Reduction in 90UCL with Source Control)	Cost-Benefit Slope
613	RB-10b	172	L	56	76%	0.01
156	RB-9b	63	M	53	8%	0.0015
154	RB-9a	52	M	53	6%	0.0012
110*	RB-3	43	I	35	0%	0
77.3	RB-10a	43	L	56	2%	0.0004
77	RB-2	40	J	635	4%	0.00007
72	RB-1	34	None	0	3%	--
71.1	RB-14b	30	I	35	0.4%	0.0001
Source Control Goal		29.5				

Table A-18 - Post-Source Control 90UCL Input Data
SIUF - OU2
Portland, Oregon

Cu (mg/kg)	d_Cu (mg/k	Pb (mg/kg)	d_Pb (mg/k	PCB µg/kg	d_PCB µg/kg - 613
567	1	85.6	1	110	0
271	1	77.6	1	77	1
125	1	58.2	1	72	1
112	1	51.3	1	71.1	1
96.3	1	43.2	1	58	1
92.4	1	42.6	1	26.4	1
62.5	1	36	1	25.7	1
61.4	1	30.1	1	24.8	1
60.1	1	27.2	1	12.6	1
57.2	1	24.6	1	10.3	1
46.7	1	23.2	1	9.8	1
42.4	1	21.4	1	7.8	1
25.8	1	17.1	1	6.2	0
		15.4	1	5.5	0
		12.0	1	5.5	0
		7.4	1		

Table A-19 - Riverbank Soil Post-Source Control 90UCL Output
SIUF - OU2
Portland, Oregon

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Cu (mg/kg)

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		Log-transformed Statistics	
Minimum	25.8	Minimum of Log Data	3.25
Maximum	567	Maximum of Log Data	6.34
Mean	124.6	Mean of log Data	4.448
Median	62.5	SD of log Data	0.813
SD	146.7		
Std. Error of Mean	40.69		
Coefficient of Variation	1.177		
Skewness	2.701		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.619	Shapiro Wilk Test Statistic	0.918
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	179.8	90% H-UCL	182.8
		90% Chebyshev (MVUE) UCL	197.7
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	235
90% Adjusted-CLT UCL (Chen-1995)	198.5	97.5% Chebyshev (MVUE) UCL	286.9
90% Modified-t UCL (Johnson-1978)	184.9	99% Chebyshev (MVUE) UCL	388.8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.181	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	105.5		
MLE of Mean	124.6		
MLE of Standard Deviation	114.6		
nu star	30.71		
Approximate Chi Square Value (.05)	21.19	Nonparametric Statistics	
Adjusted Level of Significance	0.0767	90% CLT UCL	176.7
Adjusted Chi Square Value	20.31	90% Jackknife UCL	179.8
		90% Standard Bootstrap UCL	174
Anderson-Darling Test Statistic	0.964	90% Bootstrap-t UCL	319.9
Anderson-Darling 5% Critical Value	0.751	90% Hall's Bootstrap UCL	474
Kolmogorov-Smirnov Test Statistic	0.235	90% Percentile Bootstrap UCL	176.7
Kolmogorov-Smirnov 5% Critical Value	0.241	90% BCA Bootstrap UCL	206.3
Data follow Appr. Gamma Distribution at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	246.7
		95% Chebyshev(Mean, Sd) UCL	302
		97.5% Chebyshev(Mean, Sd) UCL	378.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	529.5
90% Approximate Gamma UCL	180.6		
90% Adjusted Gamma UCL	188.4		

Table A-19 - Riverbank Soil Post-Source Control 90UCL Output
SIUF - OU2
Portland, Oregon

Potential UCL to Use — Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Pb (mg/kg)

General Statistics

Number of Valid Observations	16	Number of Distinct Observations	16
Raw Statistics		Log-transformed Statistics	
Minimum	7.4	Minimum of Log Data	2.001
Maximum	85.6	Maximum of Log Data	4.45
Mean	35.81	Mean of log Data	3.38
Median	28.65	SD of log Data	0.673
SD	22.81		
Std. Error of Mean	5.704		
Coefficient of Variation	0.637		
Skewness	0.985		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.912	Shapiro Wilk Test Statistic	0.984
Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	43.45	90% H-UCL	49.13
		90% Chebyshev (MVUE) UCL	55.51
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	64.24
90% Adjusted-CLT UCL (Chen-1995)	44.12	97.5% Chebyshev (MVUE) UCL	76.36
90% Modified-t UCL (Johnson-1978)	43.69	99% Chebyshev (MVUE) UCL	100.2
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.219	Data appear Normal at 5% Significance Level	
Theta Star	16.13		
MLE of Mean	35.81		
MLE of Standard Deviation	24.04		
nu star	71.02		
Approximate Chi Square Value (.05)	56.24	Nonparametric Statistics	
Adjusted Level of Significance	0.0809	90% CLT UCL	43.12
Adjusted Chi Square Value	55.05	90% Jackknife UCL	43.45
		90% Standard Bootstrap UCL	42.9
Anderson-Darling Test Statistic	0.138	90% Bootstrap-t UCL	44.15
Anderson-Darling 5% Critical Value	0.746	90% Hall's Bootstrap UCL	44.41
Kolmogorov-Smirnov Test Statistic	0.0898	90% Percentile Bootstrap UCL	43.19
Kolmogorov-Smirnov 5% Critical Value	0.217	90% BCA Bootstrap UCL	43.7
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	52.92
		95% Chebyshev(Mean, Sd) UCL	60.67
		97.5% Chebyshev(Mean, Sd) UCL	71.42
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	92.56
90% Approximate Gamma UCL	45.22		
90% Adjusted Gamma UCL	46.19		

Potential UCL to Use — Recommendation Provided only for 95% Confidence Coefficient

Table A-19 - Riverbank Soil Post-Source Control 90UCL Output
SIUF - OU2
Portland, Oregon

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

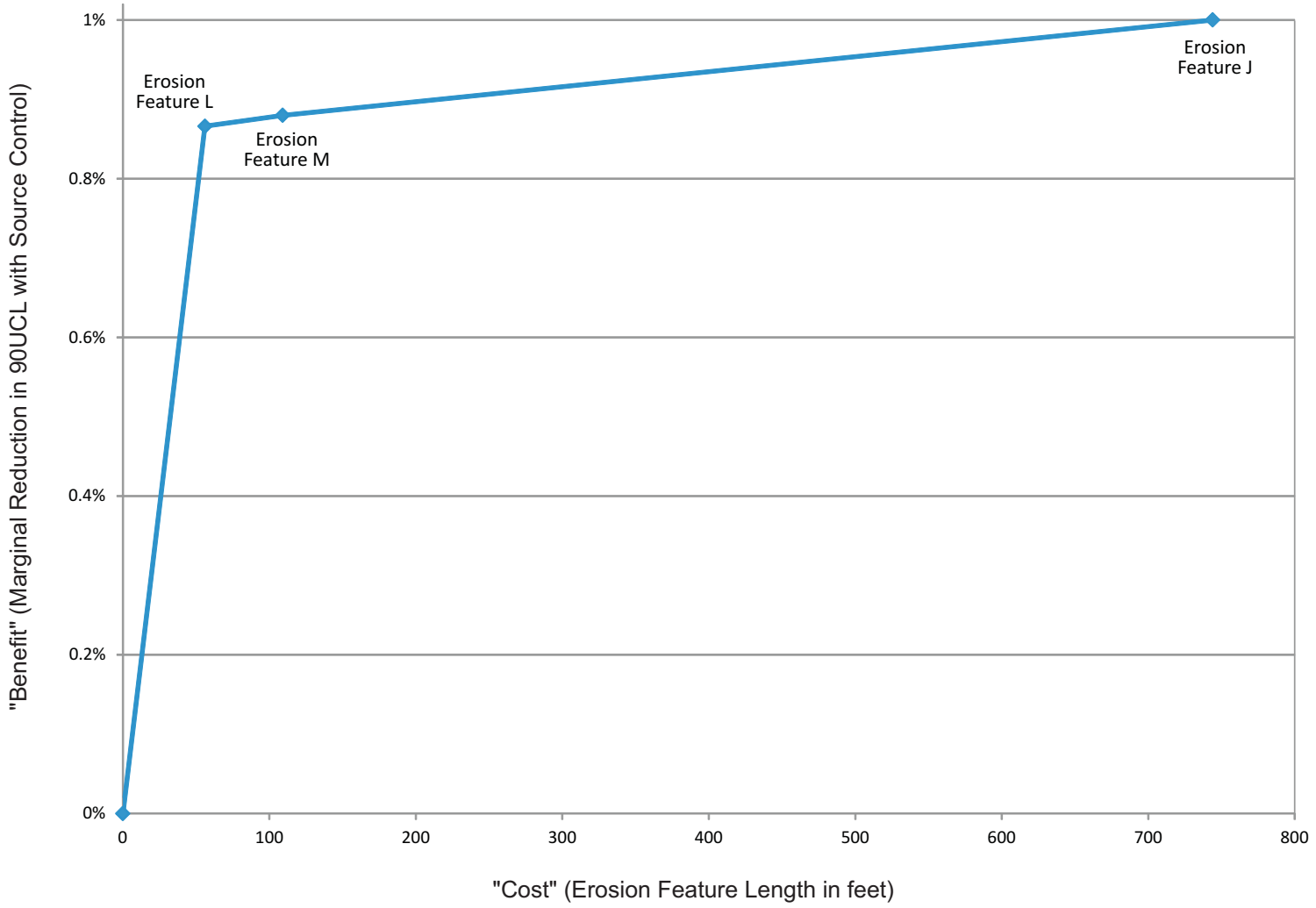
PCB µg/kg

General Statistics			
Number of Valid Data	15	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	4
		Percent Non-Detects	26.67%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.8	Minimum Detected	2.054
Maximum Detected	77	Maximum Detected	4.344
Mean of Detected	35.95	Mean of Detected	3.262
SD of Detected	27.76	SD of Detected	0.875
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	110	Maximum Non-Detect	4.7
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	15
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.825	Shapiro Wilk Test Statistic	0.885
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	30.61	Mean	2.869
SD	27.93	SD	1.212
90% DL/2 (t) UCL	40.31	90% H-Stat (DL/2) UCL	75.56
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	2.825
		SD in Log Scale	1.121
		Mean in Original Scale	28.19
		SD in Original Scale	27.16
		90% t UCL	37.63
		90% Percentile Bootstrap UCL	37.03
		90% BCA Bootstrap UCL	38.53
		90% H-UCL	59.63
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.302	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	27.61		
nu star	28.65		
A-D Test Statistic	0.624	Nonparametric Statistics	
5% A-D Critical Value	0.741	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.741	Mean	29.92
5% K-S Critical Value	0.259	SD	26.15
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	7.331

Table A-19 - Riverbank Soil Post-Source Control 90UCL Output
SIUF - OU2
Portland, Oregon

		90% KM (t) UCL	39.78
Assuming Gamma Distribution		90% KM (z) UCL	39.32
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	39.42
Minimum	1.00E-06	90% KM (bootstrap t) UCL	40.76
Maximum	77	90% KM (BCA) UCL	38.84
Mean	27.95	90% KM (Percentile Bootstrap) UCL	39.37
Median	23.75	90% KM (Chebyshev) UCL	51.91
SD	27.74	95% KM (Chebyshev) UCL	61.87
k star	0.212	97.5% KM (Chebyshev) UCL	75.7
Theta star	131.9	99% KM (Chebyshev) UCL	102.9
Nu star	6.357		
AppChi2	2.427	Potential UCL to Use	
90% Gamma Approximate UCL	73.22	Recommendation Provided only	
90% Adjusted Gamma UCL	80.69	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

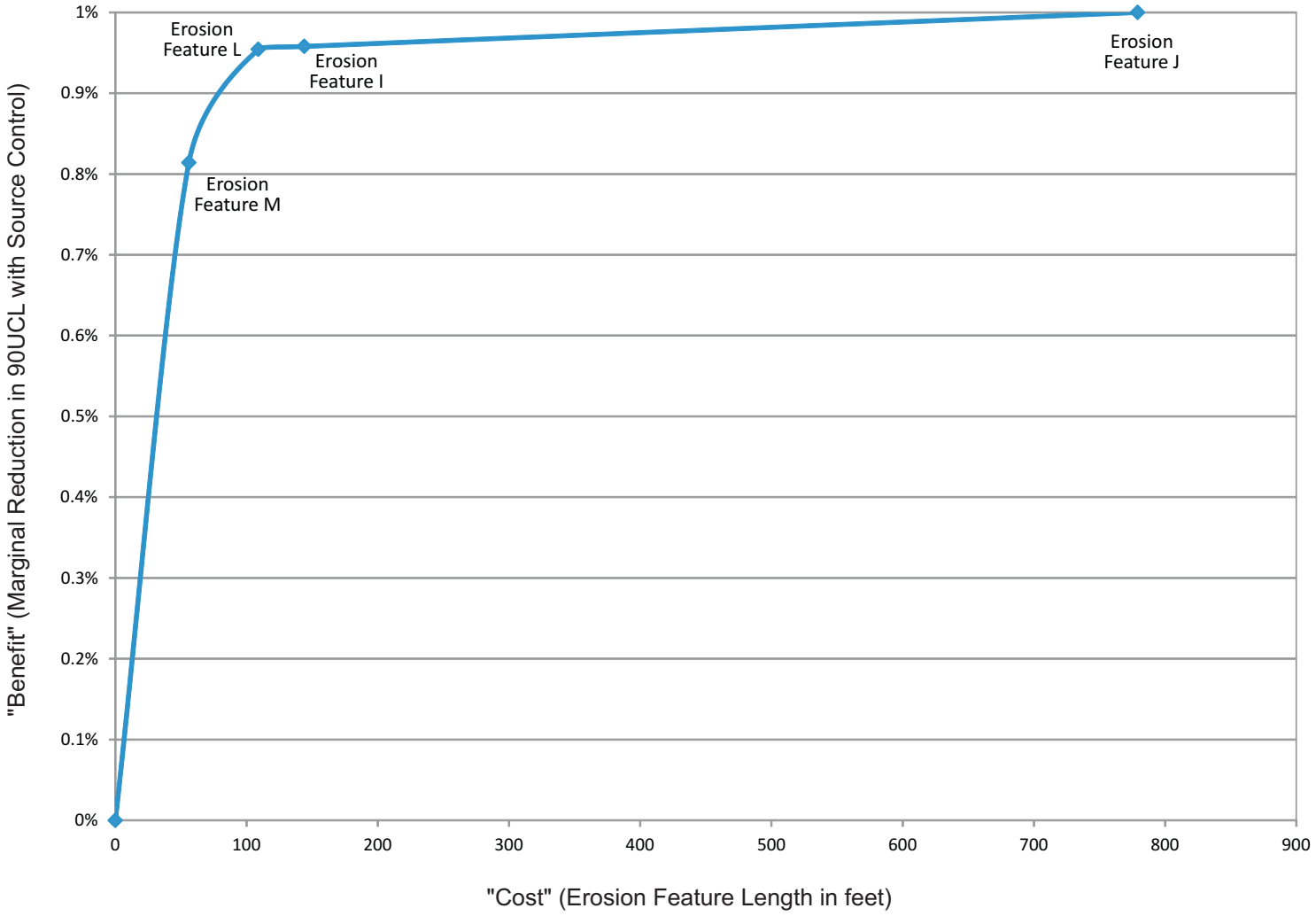


Cumulative Reduction in Copper 90UCL

Source Control Alternative Evaluation
Swan Island Upland Facility Operable Unit 2
Portland, Oregon

Ash Creek Associates
A Division of Apex Companies, LLC
APEX

Project Number	1115-05	Figure
May 2012		A-1



Cumulative Reduction in Total PCBs 90UCL

Source Control Alternative Evaluation
Swan Island Upland Facility Operable Unit 2
Portland, Oregon

Ash Creek Associates
A Division of Apex Companies, LLC
APEX

Project Number	1115-05	Figure
May 2012		A-2